THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. CXII. No. 2484.] LONDON, DECEMBER 20, 1910. [62ND YEAR. PRICE 6d.

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LUX'S PURIFYING MATERIAL.

This Material is now successfully used and highly appreciated in many Gas-Works in England and Scotland.

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Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·20.

VERY FREE FROM IMPURITIES.

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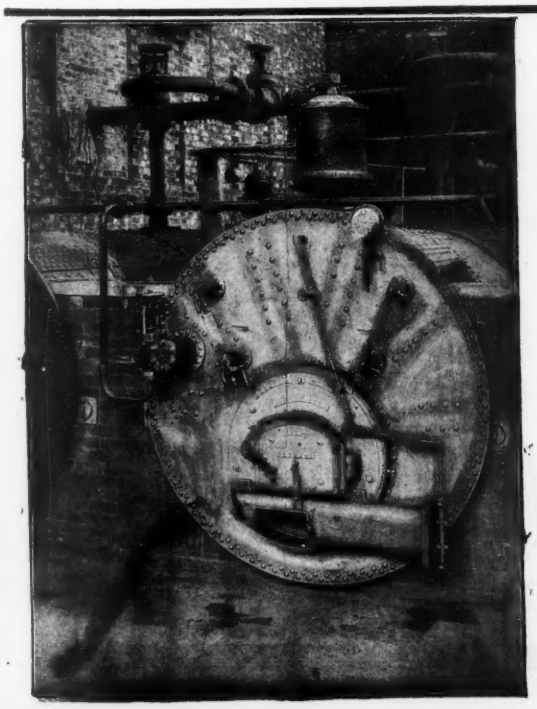

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LOW GRATE

BREEZE FURNACE.

High Efficiency.

Reduced Prices.

Recently supplied to 26 Gas-Works.

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WROT. IRON AND STEEL TUBES, AND FITTINGS OF ALL KINDS.
BRASS AND GUNMETAL FITTINGS.
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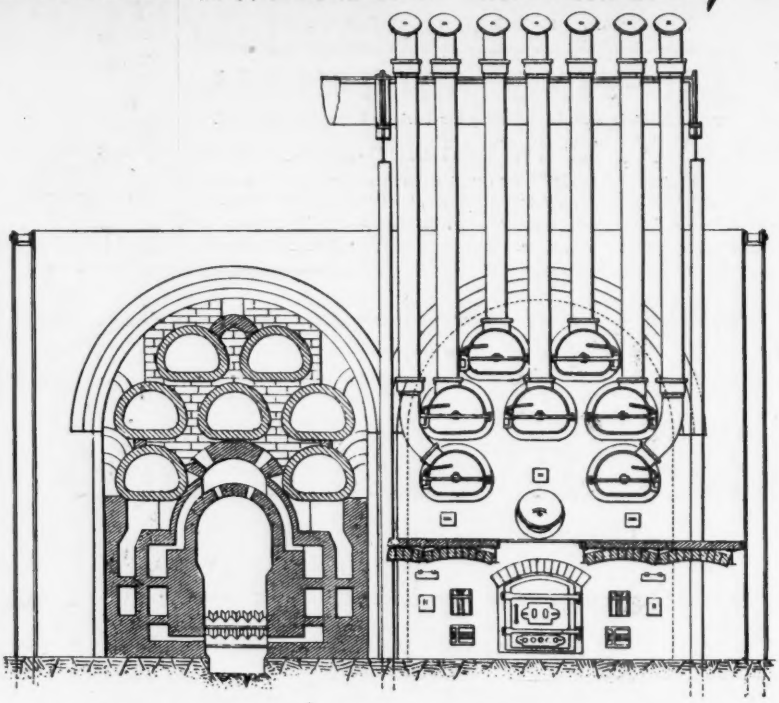

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whose quality is giving universal satisfaction.

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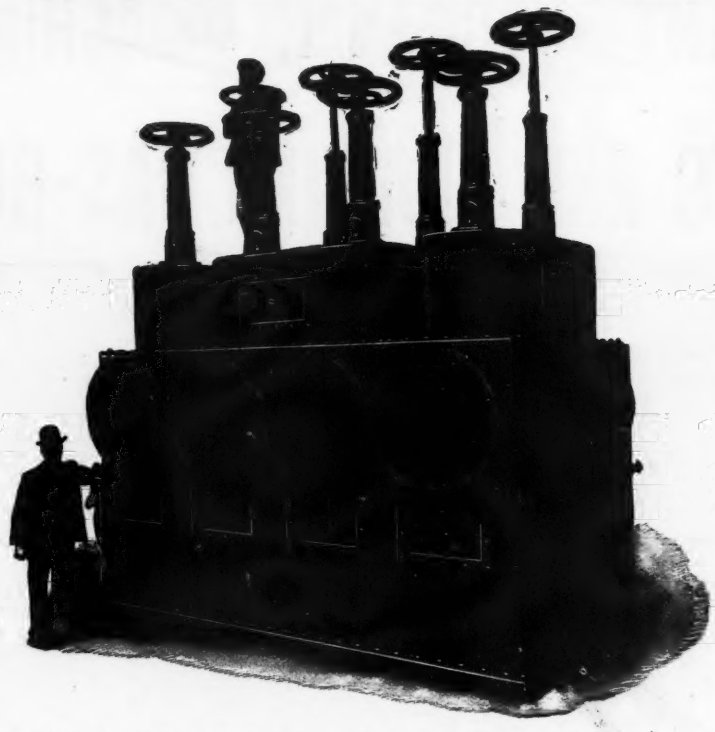

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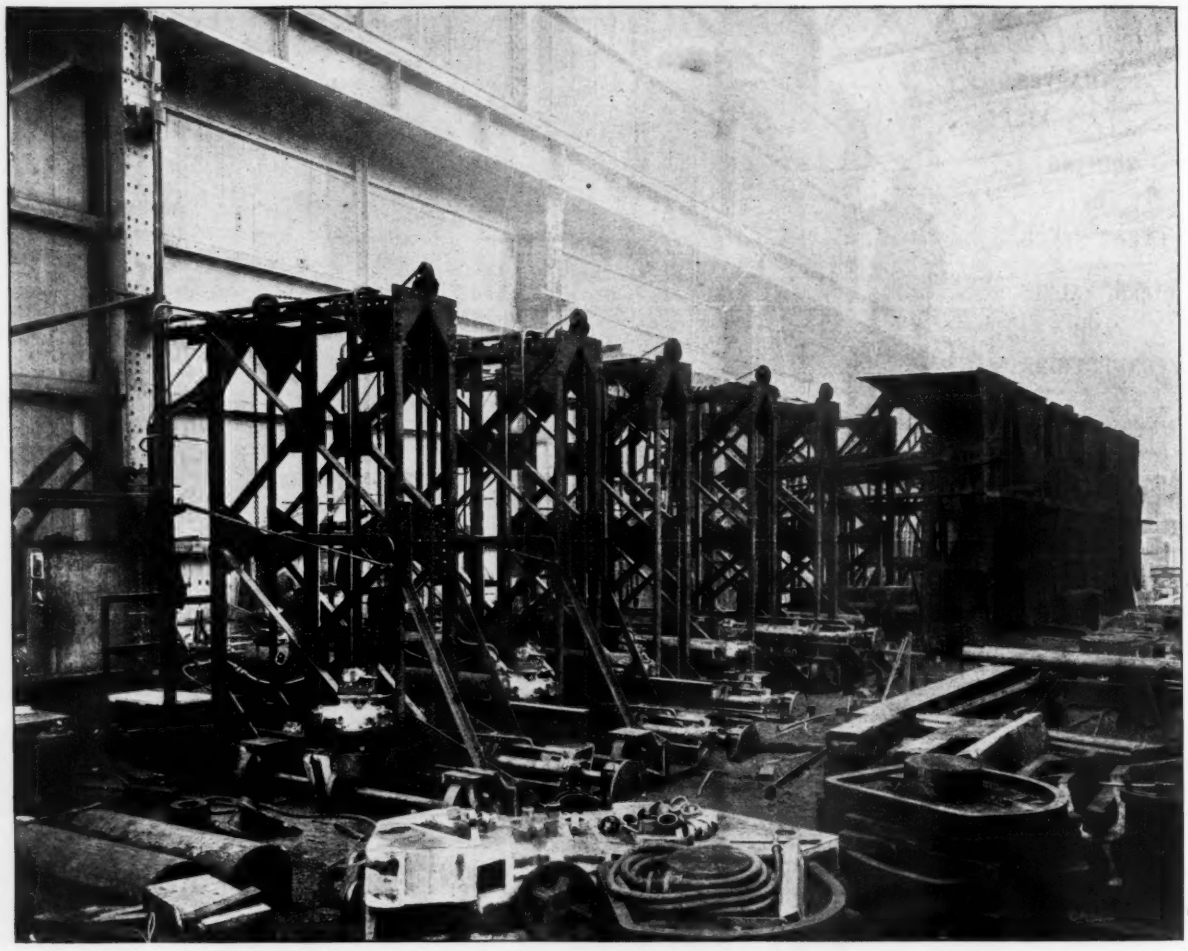

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THE
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Inverted Incandescent
Gas Burners
Are the ACME of
Efficiency, Simplicity,
Durability and Economy.

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"NICO"
MANTLES
(Inverted and Upright)
ARE
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It is the most complete and comprehensive List of "NICO" Inverted Burners, Mantles (Inverted and Upright), Gas-Fittings, Glassware (Inverted and Upright), and Accessories ever compiled).

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LEADING LINES.

No. 6 Burner.
Standard "MEDIUM" Size.

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No. 5 Burner.
Standard "BIJOU" Size.

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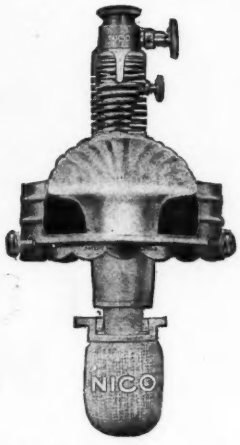

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ANTI-VIBRATING, SECONDARY AIR SUPPLY.
Perfect Combustion, Highest Possible Efficiency.
Made in Two Sizes.
No. 8. Standard large size, 100-Candle Power, Gas Consumption 3½ cubic feet per hour.
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The "NICO-RADIO" Lamp.
SELF-INTENSIFYING, OUTSIDE AIR & GAS REGULATION.
The most Efficient and Best Made Lamp on the Market for Outside Lighting.
Invaluable for SHOP, RAILWAY STATION, PUBLIC BUILDINGS, and STREET LIGHTING.

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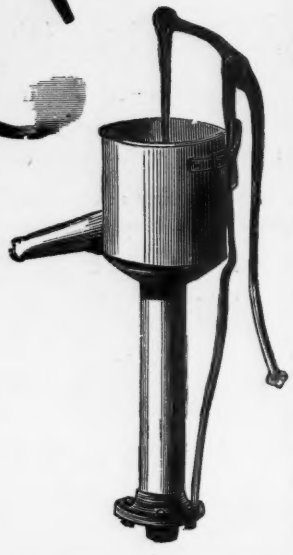
FORCE PUMP

For Small Services.

"Light, but Powerful.'



Our 'No. 49'

GALVANIZED

IRON PUMP

With 2½ in. Solid Drawn Barrel and Wrought-Iron Handle.

This Pattern is also made "All Copper."

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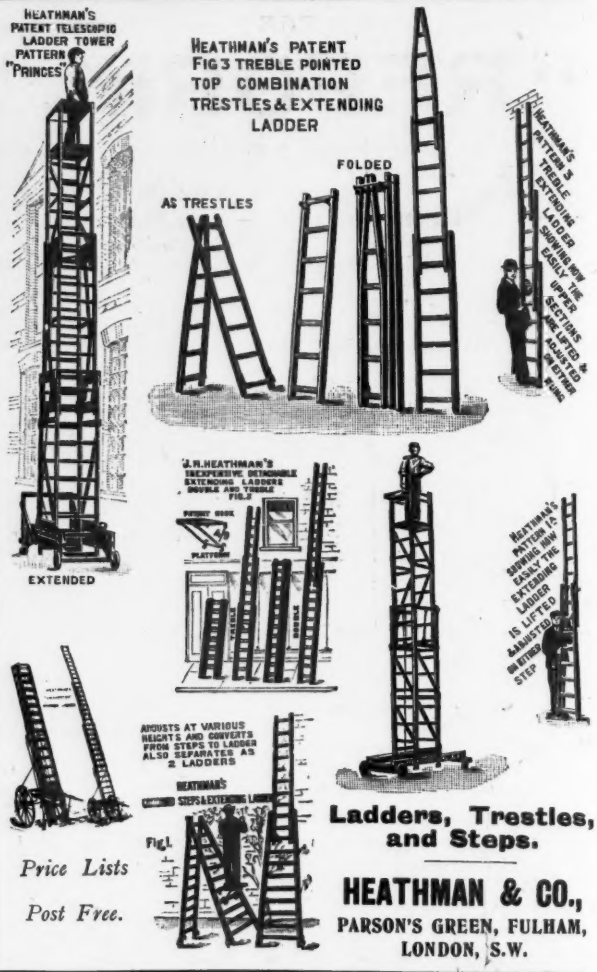
HEATHMAN'S PATENT TELESCOPIC LADDER TOWER PATTERN "PRINCES"
EXTENDED
HEATHMAN'S PATENT FIG 3 TREBLE POINTED TOP COMBINATION TRESTLES & EXTENDING LADDER
AS TRESTLES
FOLDED
HEATHMAN'S PATTERN 3 TREBLE EXTENDING LADDER SHOWING HOW EASILY THE UPPER SECTIONS ARE LIFTED & ADJUSTED TO ANY HEIGHT
J. H. HEATHMAN'S INEXPENSIVE DETACHABLE EXTENDING LADDERS DOUBLE AND TREBLE FIG. 2
PATENT HOOK
PLATFORM
HEATHMAN'S PATTERN 1 SHOWING HOW EASILY THE EXTENDING LADDER IS LIFTED & ADJUSTED TO ANY HEIGHT
ADJUSTS AT VARIOUS HEIGHTS AND CONVERTS FROM STEPS TO LADDER ALSO SEPARATES AS 2 LADDERS
HEATHMAN'S
STEPS & EXTENDING LADDER
FIG 1.

Price Lists Post Free.

Ladders, Trestles, and Steps.

HEATHMAN & CO.,

PARSON'S GREEN, FULHAM, LONDON, S.W.

B. GIBBONS, JUNR., Ltd.

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GAS RETORTS

(Horizontal, Inclined, and Vertical)

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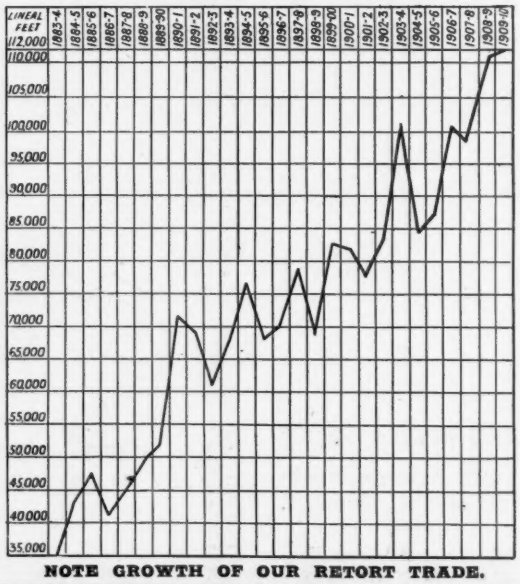
We shall place on the market an Improved Retort

ONE QUALITY ONLY

at a slight advance in price, and guarantee it second to no other make either at home or abroad.



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ONE QUALITY ONLY

at a slight advance in price, and guarantee it second to no other make either at home or abroad.

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We have for many years enjoyed the support of our Colonial Friends, and we look forward to their continued confidence.

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"REFORM."

The SMALLEST 3-Light Cluster Lamp. Height over all, 13½ ins. Diameter, 9 ins.

300-CANDLE POWER, Minimum Consumption.

No Inner Glass or Chimneys.

For Shops, Lobbies, Warehouses, &c.

Made in Steel and Copper, Bronze or Polished Brass.

9 CUB. FT. PER HOUR. Maximum Light.

Brilliant, Shadowless, and Simple.

Excellent Quality and Finish.

Nothing to get out of Order.

ALL BRITISH. **24s.,** subject.

THE

STEADY SALE

OF THE

LUCAS

SELF-INTENSIVE HIGH-POWER LAMP

Is the Best Proof of its Usefulness.

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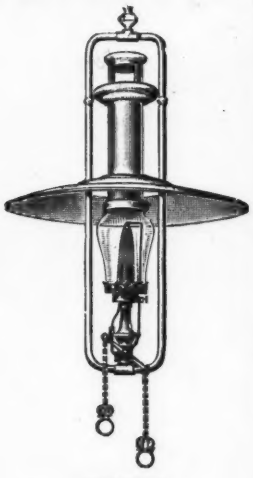

INDOOR.

ABSOLUTELY WIND, DUST, AND INSECT PROOF

200, 400, and 700-Candle Power from a Single Mantle, with Gas at its usual Pressure, and Lowest consumption on record.

MOFFAT'S LTD.

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Telephone: No. 1848 Holborn.
Telegrams: "Monadnock, London."

A.B.C. Codes, 4th and 5th Editions, also Western Union.

THE

"VISSO"

Upright Incandescent Burner

GIVES

THE HIGHEST EFFICIENCY.

30-C. P.

per c.f. with Low Pressure.

No. 0 - 1 cub. ft. per hour.
No. 3 - 3 „ „
At 20-10ths Pressure.

Awarded Gold Medal at the Brussels Exhibition.

We shall be pleased to fit up trial burners free of charge, and to send full particulars on application.

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For 'ROSS' Patent Mantles

which are braided, instead of knitted or woven, and which, on account of the resulting strength, are used by leading gas companies and consumers—

For 'PACO' China Burners

which are the 'Acme of Perfection' in inverted burners, because they possess all the advantages, but none of the disadvantages, of brass burners—

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Gas Ironing Stoves and Patent Tailors' or Laundry Irons, which are the last word in Gas and Time-saving Appliances—

Apply to the Sole Representatives—

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"Standard" Specialties.

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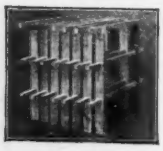
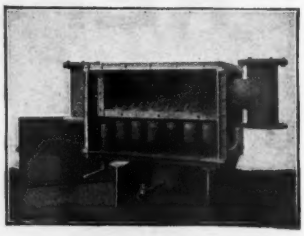


"HURDLE" GRIDS.



TAR & NAPHTHALENE WASHER.

Wrought-Iron

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LAMBERT BROS. (WALSALL), LTD.

Alpha Works, WALSALL.

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WROUGHT-IRON TUBES & FITTINGS for GAS, WATER, & STEAM.

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THE GAS-METER COMPANY,

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WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.

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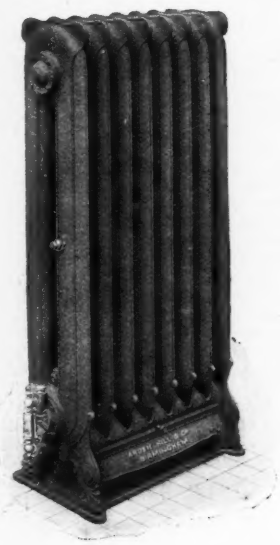
Another Important Reason

for the Popularity of the

"MARS" RADIATOR.



No products of combustion can get inside the loops, so that deposit—unpleasant smell—and consequent corrosion, are absolutely prevented,

and—

Long life and hygienic value are ensured.

More reasons to follow!

ARDEN HILL & CO.,
ACME WORKS,
ASTON, BIRMINGHAM.

255.

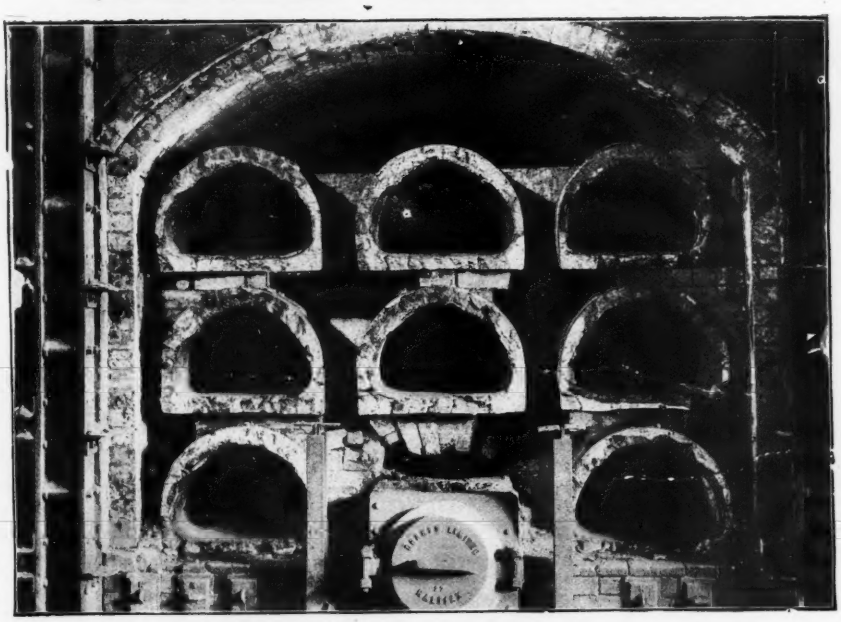
YET ANOTHER RECORD.

2323 DAYS' WORK.

All our Retorts are Patent Machine made.

Horizontal, Inclined, Vertical.

Special Patent Expanding Dies for making Taper Retorts at one operation.



Bricks, Tiles, and Blocks for all Types of Settings.

Specials.

Silica Bricks.

Alumina Bricks.

Non-Con. Cement.

REPORT.—"This Bed worked for **2323 days** at high heats, and is still in very fair condition. **Working results were exceptionally good.**"

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WORTLEY, LEEDS, ENGLAND.

Telephones:
610, 612, 1649, 2322, Leeds.

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CARBURETTED-WATER-GAS.

	Cubic Feet Daily.		Cubic Feet Daily.		Cubic Feet Daily.
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Agram, Croatia	200,000	Faversham	200,000	Perth, W.A.	125,000
Alkmaar, Holland	400,000	Flensburg, Sleswig	300,000	Poole	1,500,000
Allenstein, Germany	200,000	Forst, Brandenburg	300,000	Port Elizabeth, S.A	400,000
Antwerp, Belgium	1,500,000	Frankenthal, Germany	175,000	Portsmouth	1,000,000
Antwerp (2nd)	1,000,000	G. L. & C. Co. Beckton	2,250,000	Posen, Germany	450,000
Ashford	250,000	G. L. & C. Co., ,, (2nd)	10,750,000	Posen (2nd)	700,000
Augsburg, Bavaria	425,000	G. L. & C. Co., Bromley	3,750,000	Prague, Austria	140,000
Aylesbury	150,000	G. L. & C. Co., Fulham	1,750,000	Preston	1,400,000
Barmen-Rittershausen	500,000	G. L. & C. Co., ,, (2nd)	750,000	Reading	1,000,000
Barrow	300,000	G.L. & C.Co., Kensal Green	2,250,000	Redhill	275,000
Barrow (2nd)	500,000	G.L. & C.Co., ,, (2nd)	2,250,000	Redhill (2nd)	300,000
Bath	1,000,000	G. L. & C. Co., Nine Elms	2,750,000	Reichenberg, Bohemia	200,000
Belfast	1,700,000	Gablonz, Austria	140,000	Reichenberg (2nd)	200,000
Belfast (2nd)	4,500,000	Gelsenkirchen, Westphalia	175,000	Revel, Russia	350,000
Benrath, Germany	125,000	Gelsenkirchen (2nd)	350,000	Rhymney Valley	175,000
Berlin—Charlottenburg	2,500,000	Geneva, Switz.	500,000	Romford	300,000
Berlin—Rixdorf	650,000	Gosport	200,000	Romford (2nd)	350,000
Berlin—Rixdorf (2nd)	700,000	Göteborg, Sweden	300,000	Rotterdam, Holland	850,000
Berlin—Tegel	3,500,000	Göteborg (2nd)	600,000	Rotterdam (2nd)	1,500,000
Berlin—Tegel (2nd)	6,350,000	Graudenz, Prussia	200,000	Rotterdam (3rd)	750,000
Bilston	375,000	Guildford	350,000	Rotterdam (4th)	750,000
Birmingham	1,500,000	Guildford (2nd)	200,000	Rotterdam (5th)	600,000
Bishop's Stortford	200,000	Haarlem, Holland	850,000	St. Albans	700,000
Bochum, Westphalia	530,000	Hamburg, Germany	1,750,000	St. Gallen, Switz.	225,000
Bognor	100,000	Hampton Court	500,000	St. Gallen (2nd)	225,000
Bordentown, N.J.	125,000	Hampton Court (2nd)	600,000	St. Joseph, Mo.	750,000
Bournemouth	1,000,000	Hartlepool	750,000	San Paulo, Brazil	700,000
Bournemouth (2nd)	500,000	Hebden Bridge	200,000	Santiago de Cuba	400,000
Bremen, Germany	550,000	Heidelberg, Germany	200,000	Scarborough	800,000
Bremen (2nd)	950,000	Holyoke, Mass.	600,000	Schwelm, Westphalia	100,000
Bremen (3rd)	850,000	Hong Kong	450,000	Shanghai	225,000
Brentford	1,200,000	Hull	1,500,000	Shanghai (2nd)	225,000
Brentford (2nd)	850,000	Ilford	650,000	Shanghai (3rd)	1,600,000
Brentford (3rd)	350,000	Innsbruck, Austria	200,000	Southampton	800,000
Bridgwater	200,000	Ipswich	750,000	Southampton (2nd)	500,000
Bridlington	150,000	Kampen, Holland	350,000	Southampton (3rd)	600,000
Bridlington (2nd)	200,000	Kiel, Sleswig	1,000,000	Southgate	400,000
Brieg, Silesia	100,000	Kiel (2nd)	880,000	Southport	750,000
Brighton	1,750,000	Kolozvar, Hungary	100,000	Southport (2nd)	900,000
Brighton (2nd)	1,850,000	L. & N.W. Rly., Crewe	700,000	South Shields	650,000
Bromley	1,500,000	Lausanne, Switz.	250,000	Stafford	500,000
Bruges, Belgium	200,000	Lawrence, Mass.	400,000	Staines	600,000
Brussels—Anderlecht	350,000	Lea Bridge	350,000	Stettin, Germany	880,000
Brussels—Anderlecht (2nd)	350,000	Lea Bridge (2nd)	350,000	Stockholm	1,500,000
Brussels—Forest	1,000,000	Lea Bridge (3rd)	400,000	Stockholm (2nd)	1,750,000
Brussels—Koekelberg	1,000,000	Lea Bridge (4th)	1,000,000	Stockport	600,000
Brussels—St. Gilles	1,000,000	Leeuwarden, Holland	400,000	Stockport (2nd)	600,000
Brussels—St. Josse	1,000,000	Leiden, Holland	500,000	Stockport (3rd)	400,000
Brussels—St. Josse (2nd)	600,000	Leiden (2nd)	575,000	Stockton-on-Tees	500,000
Brussels—St. Josse (3rd)	775,000	Leigh, Lancs.	350,000	Swansea	750,000
Brussels—Ville	750,000	Lemberg, Galicia	260,000	Swansea (2nd)	1,000,000
Brussels—Ville (2nd)	750,000	Lemberg (2nd)	500,000	Swansea (3rd)	450,000
Brussels—Ville (3rd)	1,500,000	Liége, Belgium	1,000,000	Swindon	300,000
Brussels—Ville (4th)	350,000	Liége (2nd)	750,000	Swindon (2nd)	450,000
Bucarest, Roumania	1,100,000	Lincoln	500,000	Sydney—Harbour	500,000
Budapest, Hungary	50,000	Liverpool	3,500,000	Sydney—Harbour (2nd)	500,000
Budapest (2nd)	1,750,000	Liverpool (2nd)	4,500,000	Sydney—Mortlake	500,000
Carlisle	600,000	Liverpool (3rd)	750,000	Sydney—Mortlake (2nd)	500,000
Carlsruhe, Germany	500,000	Longton	600,000	Syracuse, N.Y.	850,000
Chigwell	350,000	Louvain, Belgium	800,000	Taunton	225,000
Chorley	300,000	Lübeck, Germany	400,000	Taunton (2nd)	350,000
Commercial, London	850,000	Maastricht, Holland	200,000	The Hague Holland	1,000,000
Commercial (2nd)	850,000	Magdeburg, Germany	1,400,000	The Hague (2nd)	500,000
Commercial (3rd)	1,250,000	Maidenhead	225,000	Tilburg, Holland	400,000
Commercial (4th)	2,000,000	Maidenhead (2nd)	225,000	Torquay	350,000
Copenhagen	700,000	Maidstone	500,000	Tottenham	750,000
Copenhagen (2nd)	2,500,000	Malines, Belgium	500,000	Tottenham (2nd)	750,000
Courtrai, Belgium	250,000	Malmö, Sweden	350,000	Tottenham (3rd)	350,000
Coventry	600,000	Malta	400,000	Tottenham (4th)	1,000,000
Coventry (2nd)	600,000	Manchester	3,500,000	Tottenham (5th)	1,000,000
Cracow, Galicia	200,000	Manchester (2nd)	3,500,000	Tottenham (6th)	1,250,000
Cracow (2nd)	200,000	Mansfield	330,000	Tunbridge Wells	1,000,000
Crefeld, Germany	500,000	Marlborough	100,000	Utrecht, Holland	1,000,000
Croydon	1,250,000	Mayence, Germany	700,000	Utrecht (2nd)	1,000,000
Croydon (2nd)	625,000	McKeesport, Pa.	500,000	Verviers, Belgium	1,000,000
Croydon (3rd)	625,000	Merthyr Tydfil	300,000	Vienna	3,500,000
Croydon (4th)	550,000	Middlesbrough	1,250,000	Vienna (2nd)	2,500,000
Debreczin, Hungary	100,000	Namur, Belgium	175,000	Waltham	400,000
Deventer, Holland	150,000	Nelson	400,000	Wandsworth & Putney	1,800,000
Deventer (2nd)	200,000	Newburgh, N.Y.	600,000	Watford	300,000
Dorking	150,000	New York	5,200,000	Watford (2nd)	350,000
Dublin	2,000,000	Nictheroy, Brazil	250,000	Wellington, N.Z.	350,000
Dublin (2nd)	2,000,000	North Middlesex	150,000	West Bromwich	550,000
Dublin (3rd)	650,000	North Middlesex (2nd)	200,000	West Ham	1,500,000
Dundee	1,500,000	North Middlesex (3rd)	75,000	West Ham (2nd)	800,000
Dunedin, N.Z.	150,000	Norwich	1,000,000	Weston-super-Mare	350,000
Dunedin, N.Z. (2nd)	275,000	Norwich (2nd)	300,000	Weston (2nd)	350,000
Durham	200,000	Norwich (3rd)	500,000	Wexford, Ireland	100,000
Düsseldorf, Germany	1,000,000	Nottingham	1,000,000	Wiesbaden, Germany	850,000
Eastbourne	1,250,000	Nottingham (2nd)	1,000,000	Winchester	225,000
Edinburgh	2,000,000	Nuneaton	125,000	Winchester (2nd)	125,000
Epsom	225,000	Oberhausen, Germany	175,000	Wolverhampton	1,500,000
Epsom (2nd)	300,000	Oldenburg, Germany	200,000	Zwolle, Holland	200,000
Essen	1,400,000	Ostend, Belgium	100,000	Zwolle (2nd)	200,000

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CONTENTS.

EDITORIAL NOTES.

GAS, &c.—
- A Specification for Retort Material . . . 831
- The Partial Illuminating Expert. . . . 832
- Gas for Industrial Purposes 833
- A Live Subject 833
- Seasonable Fiction 833
- Parliamentary Representation — Experimental Lighting in the City—Points to Bear in Mind—An Effective Advertisement—A Surcharge before the Courts—Rumoured Coalite Reconstruction . . 834

Gas Stock and Share Market 835
Electricity Supply Memoranda. 835
Gas and Electricity Tests at Canterbury . . 837
Physical Society's Exhibition 837
Improvements in the Treatment of Gases . 837
Lighting of the City of London 838
Institution of Gas Engineers — Standard Specification for the Manufacture and Testing of Retort Material 839
Glover-West Vertical Retorts for Bradford . 840
Dr. Rudolf Lessing on Refractory Materials and their Testing 841
Yorkshire Junior Gas Association 844
Gas for Industrial Purposes. By L. F. Tcoth 844
London and Southern Junior Association . 847
Controlling the Working of Gas-Works. By Dr. Knublauch 847
Manchester Junior Association at Southport. 849
Scottish Junior Gas Association (Western District)—Annual Social Gathering . . . 850
Extracting Cyanogen from Coal Gas. By M. E. Mueller 851
Gas at the Scottish National Exhibition . . 853
Fire-Bricks. By E. M. Stewart 854
Wellingborough Water-Works and Softening Plant. By E. Young Harrison 856
Gauging and Recording Flow of Streams. By S. C. Chapman 857

REGISTER OF PATENTS.

Locking Cash Receptacles for Coin-Freed Gas Apparatus—Schönfeldt, F. 859
Money Box for Prepayment Gas-Meters—Ainley, L. 859
Cooling and Washing Coal Gases—Whittaker, E. 859
Vertical Retort Settings—Gibbons Brothers, Limited, Masters, R., and Van Marle, M.. 860
Manufacture of Illuminating and Heating Gas—Burton, W. A. 860
Carbonization of Coal—Pringle, R. W., and Richards, L. S. 861
Burners for Incandescent Gas Lighting—Falk, Stadelmann, and Co., Limited, and Elliott, G. W. 861
Controlling the Supply of Gas to Burners—Keith, J. & G. 861
Gas-Fires—Yates, H. J. 861
Water-Heaters—Parkinson Stove Company and T. E. Barralett. 862
Insect-Proof Gas-Lanterns—Glover, R. B. G. 862
Measuring Gas—Inhoffen, R. 862
Applications for Letters Patent. 871

CORRESPONDENCE.

Carbonization in Vertical Retorts 863
Relative Effects of Gas and Electric Lighting on the Purity of the Air of Rooms . . . 863

LEGAL INTELLIGENCE.

The Law as to Fencing Excavations . . . 863
Gas and Water Companies in Liquidation . 863
Natural Gas Supply in Canada 863
The Affairs of Mr. E. O. Preston 864
Income Tax Allowance for Depreciation . . 865
Dangers of Street Boxes 865

MISCELLANEOUS NEWS.

Prepayment Meter Charges in Manchester . 865
Poisoned by Coal Gas 866
Ventilation of Street Boxes 866
Electricity Supply to Small Houses . . . 866
Metropolitan Water Board 867
Notes from Scotland 867
Current Sales of Gas Products 868
Coal Trade Reports 869
Tar Products Prices 872
Gas Stock and Share List 872

PARAGRAPHS.

Cost of Gas and Electric Current 835
Awards at the Buenos Ayres Exhibition—The "Bamag" Distance Lighter . . . 838
Advertising Gas 844
Society of Enginers (Incorporated) . . . 848
Society of Chemical Industry—Book-Keeping for Gas-Works—Industrial Pyrometry . . 850
Prepayment Gas-Meters Used as Savings Banks. 868
Reduction in Price at Brighton—Financial Position of Colwyn Bay—Electric Light Failure at Middlesbrough — Coggleshall New Water-Works—Sowerby Bridge Gas Manager's Salary Advanced 869
A Social Gathering at Greenwich—Exmouth Water-Works Extensions—Extensions at the New Mills Gas-Works—Royal Engineers at the Taunton Water-Works—Suicide by Gas in Birmingham 870
Monte Video Gas and Water Supply—Exeter Corporation and the Standard Burner Bills—Thefts from Prepayment Gas-Meters—Lighting of East Stonehouse 871

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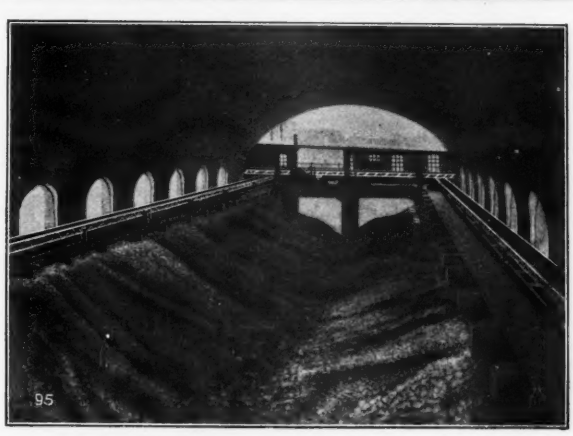

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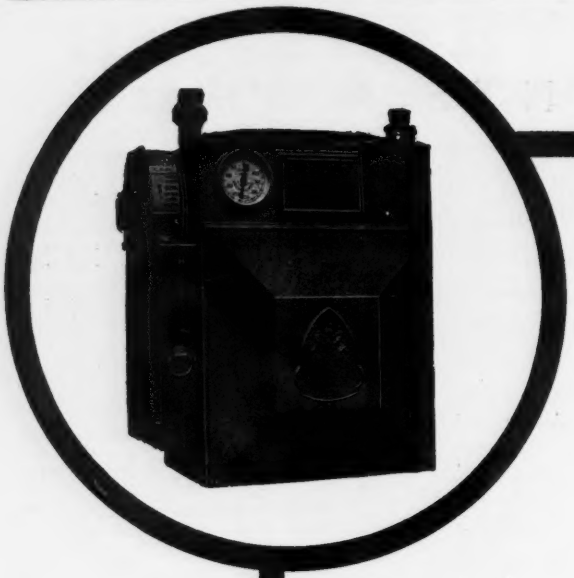

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EDITORIAL NOTES—GAS, &c.

A Specification for Retort Material.

WHEN Mr. F. J. Bywater read his paper on "Refractory "Materials" before the Institution of Gas Engineers, it was thought by not a few (though, on the other hand, he received the support of many) that his indictment of the methods and the productions of British manufacturers of refractory materials such as are employed in gas-works was somewhat severe. Whether or not that was so is not a matter for discussion to-day; but rather thanks are due to Mr. Bywater for the bold action he then took, for it was the initial step that, succeeded by others, has shown that the British manufacturers of retorts and other fire-clay goods were not so much to blame, as at first sight appeared, for any truth that existed in the charge, as the conditions under which they were labouring. To an extent, they were operating in the dark; there was not that intercommunication between their methods and practical uses in gas-works that was desirable to attain the best ends. This was made apparent when, at the last meeting of the Institution, on the presentation of a report showing the pyrometrical results of an investigation carried out at a large number of gas-works under the direction of the Refractory Materials Committee (which was an appointment directly arising out of Mr. Bywater's paper), Mr. W. P. Gibbons, the Chairman of the Fire-Brick Section of the Society of British Gas Industries, and one of his fellow members of that section, Mr. C. W. Thomas, acknowledged that the report contained information which the makers had been wanting for years, and that it would be of considerable value, and they there and then pledged the makers to do their utmost to further the objects the Committee had in view. That pledge has been, and is being, fulfilled; and British gas undertakings must do their part now to encourage the manufacturers, and keep open the communication, want of which hitherto has been proved to have been largely responsible for somewhat rigidly pursued traditional methods. What has now been done has disclosed precisely where we are, and what is wanted, in this matter of the production of refractory goods suitable to gas-works purposes; and in this is the complete answer to any who may regard it as presumptuous on the part of gas engineers to have interposed in this manner in the operations of an industry from which they draw supplies that are, of all parts of an entire gas plant, subject to the most drastic actions. When producers and users of any commodity or article of utility are out of touch, then it is high time, in the interests of both, to bring them together.

It should be acknowledged, before referring to the specification (published elsewhere in this issue) for the manufacture and testing of retort material, that the Refractory Materials Committee, of which Mr. James W. Helps is Chairman, has proved itself one of the most diligent that the Institution has ever appointed; and the members have, in dealing with the duty delegated to them, made one of the most thoroughgoing investigations that the Institution has ever taken in hand. We feel secure against any denial, but very confident of support from his associates in the work, of the assertion that, in no small measure, this is due to the energy and the belief in the intrinsic value of the task in hand of Mr. Bywater, the Hon. Secretary. But to the first specification. It is the work of a Joint Sub-Committee (over which Dr. Harold G. Colman presided) of five representatives elected by the Retort and Fire-Brick Section of the Society of British Gas Industries, and an equal number of members of the Refractory Materials Committee; and in obtaining guidance in resolving upon the terms of this specification, they have had the highly valued assistance, as technical adviser and investigator, of Dr. J. W. Mellor, of the Staffordshire County Pottery Laboratory, of Stoke-on-Trent. This is the first commendable feature about the specification—that it is submitted for acceptance as the product of a joint body equally representative of makers and users, and is not a mere code of requirements of only one party to a matter subject to mutual contract. The next notable point is that the Committee are not attempting too much at a time. They prefer step-by-step progress. This first specification only deals with the manufacture of retort material and the tests to be applied; and fire-brick material, blocks, tiles, &c., are to have a separate specification, the appearance of which may be expected in the spring of the New Year. Even then the work of the Committee will not be finished, as it is proposed to undertake an inquiry into the thermal conductivity of various kinds of retort material—a quality which (as the Committee's report says) is considerably influenced by the texture. Furthermore, the specification now issued is merely to be taken as introductory and, so to speak, tentative; so that the tests may be strengthened as may be found reasonable with time and experience.

The caution thus evidenced in the Committee's procedure will, we are sure, commend itself as judicious, inasmuch as there is in this co-operative work much that is in the nature of a new, and therefore previously untried, route to a specific end. The makers showed that they would welcome guidance to the proper meeting of requirement; and the main purpose the present specification is intended to serve is as a lead to them in the right direction. But it is not to be taken as marking finality; for as development proceeds, it may be found possible to specify somewhat more stringent tests. It will also be observed that the specification does not intrude into the region of the manufacturers practical operations. It merely says what is required; and it is for the manufacturer to employ what methods and mixtures he, through experience and investigation, finds best to comply with his customers' demands. This again is prudent. The manufacturer will now know precisely what conditions he has to meet, and to what standard tests his products will be exposed (until such time as there may be revision); and there is confidence that British manufacturers will not—the spirit with which they have entered into this inquiry, and the arrangement of, if so they may be called, the terms of agreement declare it—be found wanting in doing what is requisite. It would, in our opinion, have been extremely unwise in such work as this to have attempted to reduce methods and mixtures to prescription; for in manufacture there is nothing that militates more against individual effort in the development of a higher status for any form of production, than to hedge it round with definitions that must not be varied. The only stipulation in connection with the materials is found in clause 1, in which there is a statement as to the general character of the material needed for resisting the rapid changes of temperature to which retorts are subject. What is required here is the exclusion of all dust and very fine material from the "grog" or burnt clay. The want of exclusion is one of the chief reasons for the material hitherto having been so dense and close-grained, which characteristics cause it to crack when exposed to variations of temperature. Another fruitful cause of the latter is insufficient burning, to which is attributable the shrinkage when the material is brought into ordinary service. These are the reasons for the porosity and contraction tests mentioned in the specification.

Speaking generally, the tests prescribed have had no haphazard birth. They are based on a thorough investigation by Dr. Mellor with examples of materials from all quarters for the purpose of ascertaining their porosity, and the extent of contraction and expansion on heating. The Committee have not sought to effect any violent departure from present practices; and for every line of their specification sound technical reason can be adduced. But while this is so, the tests presented are rather below the average of the results obtained with the best materials upon which investigation

was made. This is the reason for the suggestion that no finality, in degree, has been reached in respect of certain of the tests. Take the tests for contraction and expansion, the criticism may be heard that these are of scarcely sufficient severity to ensure good material. They have been purposely placed low for the present in deference to the wishes of the manufacturers. The explanation of the Committee suffices. The test for refractoriness of retorts will be regarded as satisfactory, in view of the Committee's report, presented last June, on the average of actual temperatures found in retorts under ordinary working conditions. The piece of material submitted to test is to show no signs of fusion when heated at a temperature not less than Seger Cone 28 (about 1630° C.). This is the equivalent of 2966° Fahr.; while the average maximum of actual temperatures found by the experiments under working conditions, as stated in the June report, was 1909° Fahr. The subsidiary conditions in the specification will be subscribed to as being equitable to both parties to a retort contract.

Heedful reading of the specification convinces as to the care and reasonableness that have been exercised in its preparation, especially in view of it representing the first movement in striking out into new lines of co-operative work for mutual benefit in this particular line of goods. If engineers and manufacturers will only give the specification a fair trial (allowing, as the Committee suggest, for a time, some little latitude in the interpretation of the conditions), there is confidence that it will soon result in better retort material being available. As a matter of fact, the material that will satisfy the prescribed tests, it may be taken, will be of somewhat higher standard than that represented by the definition. We congratulate the Committee on the service that has so far been rendered in this matter to the gas industry by the exertions they have put forth.

The Partial Illuminating Expert.

In the cause of street illumination, there is not voluntarily a busier man than Mr. Haydn Harrison; and if he does not make a name as a suitable consultant for local authorities prepossessed by electrical illumination, it will assuredly not be his fault. In the midst of his professional work, he has, within quite a small number of days, found time to read a paper before the Institution of Electrical Engineers, take part in a discussion at the Society of Illuminating Engineers, and, in addition, write an article on "Lighting London as "a Fine Art" for the "Evening News." The ostensible objects of the article are to condemn the amazing variety of lamps there are to-day in the streets of London, to advocate —naturally—that the local authorities should take counsel with the illuminating expert (most of those with whom we have had experience, either personally or through their writings, are conscientiously partizan), and to laud the adoption of greater uniformity in street lighting by the application of frequently placed low units of light on brackets affixed to houses to avoid glare and obstruction. And we have not the slightest doubt that metallic filament lamps enclosed in lamps with fittings designed by this censor and mentor of the Metropolitan lighting authorities would meet with his sincerest and unqualified approbation. But we think that Mr. Harrison is a man who is in too great a hurry. Order cannot be produced in a day from such chaos as exists in connection with the lighting of London. The Gas Companies are working hard to the ends of improvement and greater uniformity. In Westminster, the City Council are doing excellent work in these directions, and without the aid of any "expert" outside their own body; and they are accomplishing precisely what (in the part of the article not dealing with uniformity) Mr. Harrison says they should do, and what would be done if an "expert" were employed—that is giving to the various streets an illumination "in propor- "tion to their importance." There are now in use in Westminster thousands of inverted gas-burners (about which this partizan illuminating expert does not say anything) all of the same type; and thousands of others of the same model are now going into the streets of Hackney, Bethnal Green, Finsbury, Stoke Newington, and possibly of other boroughs. The same applies to the spread of inverted gas-lighting in the south of London. This being so, the march to street lighting improvement and greater uniformity, precisely as Mr. Harrison advocates, has well started, and that without the aid of any outside illuminating experts. This work, too, on the part of the Gas Companies is rousing the electricity suppliers to a better sense of their duty, and has put them on the defensive, with the result that the old-style electric arc lamps are being displaced in feverish haste, in certain important situations, in favour of flame arc lamps, and as a consequence greater glare and unsteadiness are being introduced into the streets.

However, we have a few words to say to Mr. Harrison on this subject of glare. No one would accuse him of being an independent expert; and no one would expect him to say much that is kindly on the subject of gas lighting for the streets, notwithstanding the rebutting evidence existing in London to-day to the defamatory statements so often seen in electrical quarters concerning gas lighting. In passing, it occurs to us that we have not observed any photometrical tests published by our electrical contemporaries as to the new inverted gas lighting—high and low pressure—in Westminster. Perhaps the penal, official photometrical tests are acting as a deterrent, as we have no doubt the Gaslight and Coke Company will, under the circumstances, be on the watch for any aspersions as to dereliction of contractual duty on their part. But to the point. Looking through the article the only generous allusion Mr. Harrison makes to gas lighting is when he condescendingly sandwiches high-pressure gas-lamps between electric flame arc and metallic filament lamps in referring to efficient types. He says nothing whatever about the low-pressure inverted gas-lamp, though he submits that the ideal system of lighting would be lamps of comparatively low illuminating power spaced closer together than is now usual.

In pointing, however, to the bewildering variety of the lamps that may be seen by anyone driving from Victoria Street, Westminster, *viâ* Regent Street and Oxford Street, to Paddington, he starts by speaking of the "dazzling glare" of the 1800-candle power high-pressure lamps in Victoria Street. This dazzling-glare sensation is not experienced by us in Victoria Street, nor by anyone with whom we have come in contact who has been through the street lately after dusk. On the contrary, the eyes have experienced a comfortable feeling after passing from the dazzling glare of certain arc lamps in Whitehall to the portion lighted by high-pressure inverted gas-lamps. In his allusion to the Whitehall flame arc lamps, however, the would-be educator of London Borough Councils says nothing whatever about glare, nor does he in referring to the Regent Street lamps, or those in Oxford Street, or those in Marylebone. Only the Victoria Street high-pressure gas-lamps have the stigma of dazzling glare attached to them! In his view, the Regent Street lamps, fitted with specially designed prismatic globes, give an even and efficient illumination; while in Oxford Street "a genial warmth and comfort is diffused by the yellow arcs, "which make life worth living." On the occasion of the reading of Mr. Harrison's paper before the Institution of Electrical Engineers, Mr. A. H. Seabrook, of West Ham and Marylebone fame, asserted that the "dioptric globes in "Regent Street seemed to him to give a considerable and "unpleasant glare." This is an instance of doctors differing. As to the genial warmth and comfort of the Oxford Street yellow arcs which make life worth living, we strongly recommend the human wrecks which disgrace the Embankment at night time to transfer themselves to Oxford Street, for expert opinion declares that the flame arcs there will greatly improve their conditions and circumstances.

Of course, in Mr. Harrison's view, the Borough Councillors are a lot of ignorant fellows on this matter of street illumination; and they will never be right until they employ an expert who knows the whole science of illumination. The employment of such an illuminating expert would set things right. Illumination would be even, glaring lamps would be dispensed with—that is to say, high-pressure gas-lamps, by no means flame arcs and metallic filaments, about which we were hearing something recently at the Illuminating Engineering Society [*ante*, pp. 767, 784]—and the result would have some relation to cost. Now supposing a Borough Council took Mr. Harrison's advice, and engaged an "illuminating expert." Supposing, too, they deliberately selected, in view of his article in the "Evening News," Mr. Harrison himself. Could we venture to predict to that Borough Council the system he would advocate—gas or electric? We should have a good try, and should have a fair amount of confidence in our powers of prediction in this instance. It is feared by us that the wholly independent illuminating expert is yet unborn, and that the supreme judges must still be the local authorities when those local authorities are not, as unfortunately so many of them are, influenced by the possession of electricity undertakings.

Gas for Industrial Purposes.

THE attention that is being devoted to this subject is expanding at a rapid rate. There are some gas-supply areas in which it is more important than others; the character of the districts, whether largely industrial or purely residential, being the controlling factor, while the characters of the industries also affect the matter. But, speaking generally, there is, as Dr. Schilling was illustrating to our German friends away last June, a big field for the development of the uses of gas in industry. In our opinion, we are only at the fringe of this industrial gas business at present. That the business exists in some districts, but only awaits development, is shown by what the Sheffield Gas Company succeeded in accomplishing, in a very brief period, in the placing of gas-furnaces. That there is a big belief in the future of this "line" of trading is also very clearly shown by what is being done in Birmingham, in the distribution of gas for industrial purposes at high pressures. The East-end of London is also a specially good field for the industrial business; industries both large and small and variegated in their character abounding there. It was not long since that the Chairman of the Commercial Gas Company (Mr. W. G. Bradshaw) was telling the proprietors that the staff were entering, with energy, upon a very promising field of business in the supply of gas-furnaces to industrial establishments; and in his address to the Southern District Junior Gas Association last Friday evening, the President (Mr. L. F. Tooth), who is connected with the sales of gas department of the Company, gave further information as to what is being done. Such addresses must contribute to development in this direction; and the suggestiveness to be drawn from experiences like those of Mr. Tooth must be of considerable use.

Mr. Tooth was suggestive. There are gas furnaces and gas furnaces for industrial use; and just any form of structure will not suffice. There must be scientific construction, and construction suitable to the object in view. We think Mr. Tooth will be prepared to say that his experience does not support Dr. Bone's theorem as to surface-contact of a gas-flame usefully accelerating combustion; for his diagrams show that in a furnace which he has designed for metal melting, where flame contact does not exist to any great degree, he gets a more rapid rise of temperature, and it is continued at a higher level when it reaches the points of temperature maxima, than where there is flame-contact with the sides of the furnace and the pot or crucible. But, of course, experiences vary with variation of condition; and when the scientists, upon whom we are prone to base our faith in such matters, do not agree, there is excuse for refusing to be too positive, or to accept any experience as being conclusive in respect of general application. Mr. Tooth's experience as to better results being obtained by fixing the burners so that the flames enter the furnace at a tangent, is confirmed by the work that has been done elsewhere, as is also the experience that only the best of refractory material must be employed for furnaces that are to be subject to high temperatures. In connection with this subject, of course, the economy of the use of gas in such industrial operations as metal melting cannot be determined alone on the fuel basis. The whole factory economy that results from such an adoption—the economy of time, any increased output per furnace or per man—must all be placed to the credit of the system. This is important.

A Live Subject.

THE specification for retort material that has been issued by the Refractory Materials Committee of the Institution of Gas Engineers overshadows all other contributions to the general subject; and, in view of the earlier comment upon that document, we must refrain from dealing at length with the papers on the topic that appear in this week's issue. It is particularly noteworthy that the paper of 1908 by Mr. Bywater gave a fillip to interest in this matter that is unexampled in recent times in connection with any other single constituent of a gas-works equipment, save, of course, the large question of carbonization plant and method. One satisfactory issue has been the manner in which the manufacturers of retorts and other fire-clay goods have thrown open their works to the inspection of members of Junior Associations; and there have been papers contributed to the technical proceedings—the one by Mr. E. M. Stewart appearing to-day is an instance—showing that the manufacturers are perfectly willing to give all information in their power, and that they have nothing that they particularly wish to hide. Incidentally, too, the contributors have disclosed that the manufacturers have not been under such complete servitude to rule-of-thumb procedure as has been too commonly imagined.

A paper that should be read in conjunction with the specification for retort manufacture and testing, is the one that Dr. Rudolf Lessing has read on "Refractory Materials and "their Testing," before the Liverpool Engineering Society. There is, however, one statement of the author which we cannot accept as any sufficient excuse for production and conditions of use being out of harmony. He submits: "The "fact that the study of refractory materials has not up to "now been a very general one is evidently due to the diffi-"culties of their examination under the conditions under "which they are used in practice—viz., at high tempera-"tures." There were, on the one hand, the makers of the goods with raw materials of excellent quality; there were, on the other hand, the gas-works with the conditions of use and the high temperatures. There was no good reason for an absence of a confluence of opportunities. But until lately producers and users have kept at arm's length—there seemed to be no thought of approaching each other—as though they had no interests in common. That is altered now; and the manufacturers have information which will be of much assistance to them in the future. There is not the slightest reason—in fact, it will be advantageous to both the producers and the users—why, in future, conditions of manufacture and use should not be kept in closer touch. For the rest, Dr. Lessing's paper was historical and informative, and in it will be found further explanations for the conditions of the new specification for retort materials and testing. One suggestion the author makes in dealing with retort-settings is that, for the outer walls, ordinary building bricks of high porosity and low thermal conductivity should be more generally used, in order to reduce, as far as possible, losses by radiation to the atmosphere of the retort-house. An integument of insulating material, or an insertion of non-conducting material between the inner and surface parts of the walls of a setting, has aiso an excellent effect in conserving heat, and in realizing some reduction of the fuel account.

Seasonable Fiction.

IT is sometimes necessary to go from home for intelligence that intimately interests one. Some astonishing statements have appeared in the "Stock Exchange Gazette" concerning certain remarkable developments that are said to be going to take place in the gas industry through means knowledge of which on our part is confessedly defective, if our financial contemporary's facts are not at fault. But we rather think that it is not our knowledge that is defective, but that our contemporary has somehow or other got into a tangle in properly allocating the facts to the past and the future. We read that "developments are impending of the highest im-"portance to the Gaslight and Coke Company; and if, as "there is every reason to believe, the necessary formalities, "which will have to be complied with, proceed smoothly, the "position of the undertaking before long will have undergone "a great change for the better." We, too, are exceedingly hopeful of seeing the Company in a better position even than it is at present; but the great change for the better has been proceeding without intermission during the past five years. The writer of the article correctly refers to certain of the powers that are to be sought by the Company in the next session of Parliament. But then he goes on to state: It is probable that in the "near future the Company will "apply to Parliament for leave to further curtail the illumi-"nating power of the gas it produces, in view of the fact "that a well-known expert has recently invented a burner "which is capable, by means of the closer regulation of the "air supply in the pipe [*sic*], to provide a flame of equal "illuminating power to that which has hitherto been pro-"duced by a higher standard of gas." Our friend has evidently only just learned of the Carpenter "Metropolitan" No. 2 burner, which has been in use as the standard for testing the illuminating power of the gas supplied by the Gaslight, South Metropolitan, and Commercial Companies since 1906, when it was first prescribed by the Metropolitan Gas Referees, in conformity with the power conferred by Parliament. Then we come to another surprising piece of information; and it is that, if Parliament sanctions this new burner, it is estimated that "the saving to the Companies "will range up to 8d. per 1000 cubic feet, according to the

"quality of the coal used for carbonizing." Since the No. 2 burner has been in use for the official testing, the price of gas has been reduced by the Gaslight Company by 4d. per 1000 cubic feet; but this 4d. (which represents upwards of £300,000 a year to the consumers on the present sale of gas) is not to be credited to the burner, but in greater part to the economies that an expansion of technical knowledge has enabled the Company to make in manufacture. The *dénouement* of this little romance is that gas consumers and shareholders in sliding-scale gas companies will be highly pleased, gas shares will go up, and the electric supply industry will be made to "sit up" even more than it has been made to do in recent times.

Parliamentary Representation.

In addition to previous notification, three other members of the new Parliament have close connection with the gas industry. Mr. W. H. Cowan continues to represent Aberdeenshire (East) as a Liberal. Mr. Alderman Cotton, Chairman of the Alliance and Dublin Consumers' Gas Company, goes to Parliament as a member of the Redmond party, representing Dublin County (South). He was only beaten in contesting the seat last January by 66 votes; and this time he secured a majority of 133. Mr. J. H. Duncan, one of the Directors of the Otley Gas Company, retains his seat, in the Liberal interest, for the West Riding of Yorks.

Experimental Lighting in the City.

It may be taken that we shall not advance far into the New Year before the Court of Common Council of the City will be considering the experimental lighting now running in their streets. In view of this, our electrical contemporaries are already bestirring themselves in an attempt to show by columns of matter that the electrical display that has been made is infinitely the better. The electrical papers, there is good ground for believing, have all been supplied with the same information from the same source; so that the City Fathers who happen to see what appears in those papers will know that the material, the adjectives, the colouring, and so forth all have a common origin. They will know, for instance, if they read that "one is immediately and forcibly struck with the vast superiority of the new electric lighting" over the new gas lighting —of course, having regard to comparable units of light, and not to the extremes of flame arcs and low-pressure lamps of between 300 and 400 candle power as are seen in both Cheapside and the Poultry—the statement means what it says, that it is "one" who has been so "immediately and forcibly struck." The "one," we believe, is Mr. Frank Bailey, the Chief Engineer and Managing-Director of the City of London Electric Lighting Company; for we assume that the typewritten matter which has reached the "Electrical Times" through him is the same that the other electrical papers will be publishing, or have commenced to publish. Taking it that there will be no denial of this, it is, we think, extremely good of Mr. Bailey to have suppled our friends indiscriminately with so much interesting copy penned by a very interested person.

Points to Bear in Mind.

Mr. Bailey does not (this is ungenerous of him) give credit to the Gaslight and Coke Company for having stirred up his own Company in this matter of street lighting, or for being the means of putting an end to the long period of supreme repose during which antiquated arcs drew from the pockets of City ratepayers a heavy sum per annum. So far as we can trace, too, he does not suggest that other people may have different views from him as to the "vast" superiority of which he speaks through our contemporaries. But the City authorities are not likely to be misled in this matter by *ex parte* expressions of opinion. There would not have been much sense in having the trial demonstration, if the Corporation were not going (as they have hitherto done during the battle of the lights in the City) to decide for themselves on the merits of the lights from the financial and efficiency points of view. The opinion of all disinterested people who have seen the centrally suspended Keith high-pressure lamps in Cannon Street is that they are equal in their illuminating efficiency to any that are shown by the electrical people—in Cannon Street or Cheapside, or standard supported in Farringdon Street—and so are the Fleet Street lamps. An eye-arresting lamp does not necessarily mean that that lamp is the most efficient illuminating agent. In the demonstration, the Gaslight Company have also proved, by what has been done in Cannon Street, the feasibility of central suspension in the case of gas-lamps, which was a point that the Streets Committee—in compliance with the (to gas) favourable report of their deputation last year—desired to have demonstrated. A drawing showing the simplicity of the suspension, travelling, and lowering and raising devices, appears in the present issue (p. 838). The members of the Corporation will look at the Cannon Street lighting as typical of high-pressure gas lighting, and will not be deceived by the flame arcs in Cheapside being in juxtaposition to low-pressure gas-lamps. The two forms of lighting have nothing about them that is comparable.

An Effective Advertisement.

It is not always easy to gauge the effect of advertising. Sometimes the results are not immediate and direct, and those who spend money and energy in this way cannot always see the fruit of their outlay. In an indirect way, the advantages of an advertisement may occasionally be seen in the manner in which it provokes rivalry. Some circulars recently sent out by the Plymouth and Stonehouse Gas Company seem to have "touched the spot" in a very effective manner. A few months ago the Electricity Committee of the Corporation were bemoaning the fact that the law did not permit them to enter into competition with the Gas Company in advertising. Now some members of the Council are seriously disturbed because the Company have issued a circular demonstrating the superiority of gas from the point of view of health as well as economy. This view is enforced in the circular by reference to the example of the Society of Medical Officers of Health, who at their London offices and exhibition rooms in Upper Montague Street, Russell Square, W.C., have discarded electricity in favour of gas. "This is one example," says the circular, "of joint experience with electricity and gas, each extending over a number of years, finally proving that gas is the most satisfactory light." It is further pointed out that many medical men show marked preference for gas over electricity, both for lighting and heating; recommending it to their patients, and using it for heating and lighting their own consulting-rooms. The action of the Medical Officers of Health appears to have made a strong impression on at least one member of the Plymouth Corporation. At the meeting of that body last week, he was anxious to know whether the medical officers spoke in their official capacity in commending gas and criticizing the electric light. What difference it would make in the actual superiority of gas or in the opinion of the medical men on the subject, whether the opinion was expressed in an official or a private capacity, is not quite clear. Nor was any light on the matter to be obtained from the Electricity Committee. All that could be said on their behalf was that inquiry should be made. The point of the thing, however, is that the circular is one which has attracted attention to the subject. If it has led to a question in the Town Council, it has, no doubt, provoked discussion elsewhere. An advertisement which does this can scarcely fail to produce good fruit; for, after all, the object of advertising is to awaken curiosity and excite inquiry. When these are aroused, the salesman must do the rest.

A Surcharge before the Courts.

A point which Counsel remarked was of the greatest importance to local authorities in England, occupied the Judges in the Court of Appeal on one or two days recently; the judgment being followed by an order that the costs on both sides should come out of the rates. Thus the people of Bournemouth—the Corporation of which town was the one concerned in the action—may console themselves with the thought that the amount which they will be called upon to pay may benefit the country generally. A casual glance at a report of the proceedings might not lead one to infer that the matter in dispute was of such great general importance as was stated in Court; but the point involved is one that it may be well to keep in mind. Briefly, the Local Government Board Auditor surcharged those members of the Bournemouth Corporation who signed a cheque for £2 12s. 6d., interest on a loan of £600, which the Corporation had been authorized to borrow, and obtained from the Wilts and Dorset Banking Company upon the security of a charge on the rates. Subsequently, the Corporation accounts were transferred to the National Provincial Bank, who paid off all sums advanced by the first-named Company, which included many other loans besides that named. The mortgage

of £600 was not, however, legally transferred to the National Provincial Bank; but the receipt for the money was endorsed thereon. The grounds of the surcharge were principally that the transaction was contrary to the provisions of the Public Health Act, 1875; that the Council had borrowed money without giving proper security; that their borrowing powers were subject to statutory conditions, and payment of interest on money borrowed without the fulfilment of these conditions was illegal; and that there was no authority in law for payment of interest on money borrowed in the way that was here adopted. The Divisional Court upheld the Auditor's objections; and the members of the Council involved thereupon took the matter to the Court of Appeal, who unanimously reversed this finding, and ordered the overcharge to be quashed. Lord Justice Vaughan Williams expressed the opinion that the borrowing in this case was not, at any stage, a borrowing for temporary purposes. The question was whether there had been a transfer of the debt with which they had to deal to the National Provincial Bank, so that the debt was a live debt. It was clear that when there was a transfer of the Corporation account from one bank to the other, it was not intended that the debt of the Corporation to the Wilts and Dorset Bank should be blotted out. The idea was that there should be a transfer of the loan and a transfer of the mortgage, securing it to the National Provincial Bank. There had been no re-borrowing; and therefore there was nothing in respect of interest on the loan for the Auditor to surcharge.

Rumoured Coalite Reconstruction.

Reconstructions are often the beginning of the end. Rumour says that the Directors of the British Coalite Company are contemplating marring the pleasures of the shareholders at Christmas time by proposing to them a scheme of reconstruction, which is a confession of the falsification of the old hopes, and of this coalite business having been constructed on shifting sands. The meeting of the shareholders is not being held so early this year; but it is stated as part of the rumour that it is to be held on the 29th inst. Is this true? If the answer is in the affirmative, Why hold it in Christmas week? Is there hope on the part of the Board that some of the discontented shareholders will be holiday making? Surely, from what is known of the affairs of the Company, a less inconvenient week for the meeting could have been chosen.

Cost of Gas and Electric Current.

At the close of the abstract of the paper on "The Requirements of Illumination and the Status of Gas Lighting," read by Mr. J. C. Briggs at the meeting of the Graduates' Association of the Institution of Mechanical Engineers on Monday last week [see *ante*, p. 776], it was mentioned that the author gave a table showing the comparative cost of gas and electric light. The table referred to did not accompany the abstract supplied to us; but we are now able to give it from a print of the paper which the author has sent. He introduced the table with the following remarks: "The improvements wrought in mantle production have in no small measure contributed to the high efficiencies and reduced maintenance costs now prevailing in gas lighting. This fact is more in evidence with the advent of the inverted burner; the suspended mantle having a distinctly longer life than the centrally supported form employed with the vertical burner. The life of the mantle employed with low-pressure burners should not be less than 500 hours, and 300 hours in the case of high-pressure; and the light-emitting power should not sensibly depreciate over this period. When this is compared with the 1000-hour Osram lamp, costing 3s. 9d., maintenance is all in favour of gas lighting."

Gas Lighting.

Burner.	Efficiency per Cubic Foot per Hour.	Consumption in Cubic Feet per Hour.	Cost in Pence with Gas at		
	Candles.		3s.	2s. 9d.	2s. 6d.
Flat-flame	3	333·3	12·000	11·000	10·000
Incand. (inverted)	30	33·3	1·190	1·090	0·999
Keith's high-pressure	60	16·6	0·597	0·547	0·498

Electric Light.

Lamp.	Efficiency per Watt per Hour.	Consumption in Watts per Candle.	Cost in Pence with Current at		
			6d.	3d.	1½d.
Carbon filament	0·028	3500	21·0	10·50	5·250
Metallic filament	0·800	1250	7·5	3·75	1·875

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 872.)

Business on the Stock Exchange last week grew quieter and quieter as the holiday time approached nearer; and the chief consideration was the settlement of the fortnightly account. Movements were irregular but slight; and the steady progress of money rates downward imparted a tone of much cheerfulness. A minor feature of the week was the discovery of a new counter in the game of speculation—viz., Tea, *vice* Rubber invalided. The opening day showed little animation; but it was cheerful and had some strong points. Government issues were firm, and Consols rose ⅛; while Rails were sympathetic. On Tuesday, fresh business was incommoded by the claims of the settlement, but the abundance of money made the general tendency quite bright. Consols gained another ¼; and Rails were lively at the prospect of pacification in the labour arena. This state of things continued through Wednesday. A good demand for Government issues sent Consols up ⅜; and in Rails some nice advances in price were made. Thursday was a quiet day—content with the present and hopeful for the future. All the leading markets were firm and almost unchanged. On Friday, there was a little of the normal realization, which affected some of the prices slightly. Consols lost ¼ out of their gains. The general tone, however, was still good. Saturday was naturally a very quiet day, and almost devoid of feature. Consols closed unchanged. In the Money Market, there was a very abundant supply demanding employment at light rates. Discount terms eased down steadily; but they rallied before the close. Business in the Gas Market was much lighter, showing unmistakable signs of the coming holidays. It was, however, fairly well distributed, and the general tendency was favourable. In Gaslight and Coke issues, the ordinary was rather inactive but as steady as a rock; all transactions being within the same limits as the previous week —105¾ to 106½. In the secured issues, the maximum was done at 87, the preference at from 103¼ to 104, and the debenture at 79 and 79½ *ex div.* South Metropolitan was steady, and did not range outside the limits of the week before—121½ to 122½. The debenture realized 81. In Commercials, one bargain in the 4 per cent. was marked at 109, and one in the 3½ per cent. at 102¾. Among the Suburban and Provincial group, Alliance and Dublin was done at 80 (a fall of 4), Brighton and Hove ordinary at 161, British at from 44⅛ special to 44¾, and (on the local Exchange) Liverpool "A" at 220. In the Continental Companies, Imperial adhered strictly to its old figures of 185½-186½, ditto debenture was done at 94⅛, Union at 89½ and 89¾ *cum div.* and at 87¾ *ex div.*, and European fully-paid at 23 15/16 to 24⅛. Among the undertakings of the remoter world, Buenos Ayres debenture changed hands at 97⅜, Monte Video at 12⅝, Primitiva at 7 5/16 and 7⅜, ditto preference at from 5 7/16 to 5⅜, ditto debenture at 97, and San Paulo at 15⅝.

ELECTRICITY SUPPLY MEMORANDA.

Electrical Engineers and Cooking and Heating—Real Cause of the Want of Progress—Comparing the Incomparable at Islington—Overtures for Peace between Wirers and Municipal Traders—Consumers and their Lamps—A Whitby Discovery—Those Concerned Satisfied with the Holborn Competition Terms.

Christmas is close at hand, and the thoughts of the Editor of the "Electrician" have been wandering to the subject of cooking and heating. Christmas and cooking and heating have something strikingly in common, and peace and goodwill to all men enter into the happy conditions of the season. But our contemporary takes up the question in a spirit of combativeness, and hurls accusations directly and indirectly at that poor long-suffering individual the station engineer. His want of qualification and his misdemeanours are many—in print. He has often been told that in the commercial struggle he is next to useless; and now he is charged with being responsible for "the scanty use at present made of electrical apparatus" for heating and cooking. His past attitude is alleged to be at fault. But that is not all. The ugly question is thrown and catches him fully and squarely in the face: How many station engineers have their meals cooked electrically, or their houses heated by electricity? The answer, of course, is just as many as are foolish. Station engineers would doubtless be interested in knowing how many electrical journalists have their meals cooked electrically or their houses heated by electricity? The force of example is great; but there are very few persons who are so benevolently inclined that they choose to be examples to others if it is going to affect both their pockets and their personal comfort.

Perhaps our contemporary has erred in assigning the cause of the want of success in electric heating and cooking to the attitude of electrical engineers. "If," it is suggested, "they themselves employed electricity for heating, cooking, and other applications, they would soon realize what is lacking for the successful development of this field." Perhaps, without putting themselves to any personal inconvenience, they have discovered what is lacking for the successful development of the field; and it may be imagined that they have found, as we have done, at other people's expense, that for any domestic heating purpose electricity sadly lacks the

B.Th.U's. necessary to make its use economical. It is said that if the "man in the street" were asked why he does not use electricity for heating and cooking, he would say that the method is too expensive, or the apparatus not satisfactory; and our contemporary asserts that judging from the replies received to inquiries, there are *many* station engineers who are not prepared to refute these statements. The testimony to the honesty in this regard of station engineers is extremely satisfactory; and we set it to their credit against the deadly-fumes slander and the misrepresentation as to electric lighting being cheaper than gas. We shall after all begin to entertain a little hope for the central station engineer. It is an unnatural thing to expect that cheapness and inefficiency should really run together. The "Electrician" seems to think that they ought to; but in its curiously illogical article, it proves that the station engineers who are not prepared to refute the statements of the man in the street are perfectly justified. Let us show this by an extract from the article: "As to electric cooking apparatus, some dissatisfaction has been expressed. Considering the lengthy period these appliances have been on the market, it is surprising that they are not more uniformly satisfactory. Take such a simple piece of apparatus as an electric kettle. The convenience of these is so easily demonstrable that little difficulty should be experienced in persuading consumers to adopt them. But the number of electric kettles in use is surprisingly small. This is partly accounted for by lack of enterprise on the part of supply engineers, and also, we must admit, to unsuitable design. Thus, many electric kettles take a very long time to boil water. . . . This is typical of many of the faults of electric utensils; the manufacturers producing articles which do not meet practical requirements." Want of progress is not so much due to the attitude of electrical engineers, as to the low calorific value of electricity and the inefficiency of the appliances. But, however much the appliances might be improved, there is a limit to the thermal value of a unit of electricity.

Electricity for public lighting is cheaper than gas lighting. At any rate, Alderman Vorley, Chairman of the Lighting Committee of the Islington Borough Council has said so; and that omniscient organ of the electric industry—the "Electrician"—also so avers, or rather it states that "it is becoming increasingly evident that the majority of gas companies are no longer able to quote, at any rate on a commercial basis, figures which can compare favourably with those now obtained with flame arcs or metallic filament lamps." If we believed in our contemporary's powers of penetration as much as it believed in them itself, we should have nothing more to say on the subject. But as it happens, we do not. Let us have a little quiet inspection of the grounds on which the fresh outbreak of electrical belief is based. Alderman Vorley has been guilty of a piece of indiscretion that one would not have expected from a man of business. He has been comparing the cost per mile of flame and other arc lamps with small unit low-pressure vertical incandescent gas-lamps, with the result that in Islington 100 miles of gas lighting cost only £13,112 under the old conditions, and 24 miles of street lighting by electricity cost £15,225. That is to say, if Islington had been content with the quantity of illumination afforded by the old-type incandescent gas-lamps, and the prices for that type of lamp (which is greater than for the higher efficiency low-pressure inverted lamps), the ratepayers might have had for only £1000 more than they are paying for electricity alone for 24 miles of street, the whole of the 124 miles of streets in the borough lighted, and been £12,000 a year in pocket. The relative prices per mile are £634·4 for electricity, and for gas £131·1. But says Alderman Vorley, comparing something for which he pays £634 per mile with something for which he pays only £131 (which any schoolboy of average intelligence would tell him is a silly thing to do, and not cricket), he gets 48,664-candle power per mile at the higher price, and only 1900 candles at the lower price. So he argues gas is dearer than electricity. The performance hardly does credit to an Alderman of the Islington Borough Council. But we beg leave to regard with a big amount of scepticism the 3500-candle power attributed to the Islington flame arcs. Now supposing we come to a fair and common basis of comparison, and take high-pressure gas-lamps as the competitors of arc lamps. Supposing the £634 per mile was handed over to the Gas Company, and they were asked to show what they could do for this amount of money per mile, instead of £131 per mile. According to the report issued last summer by the City Engineer (Mr. Frank Sumner), the over-all price of each of the Fleet Street inverted 1500-candle power high-pressure gas-lamps was £15 2s. 6d. (the Gas Company have announced a reduction in the price of gas again, to take effect at the end of this year); so that £634 per annum would pay for 42 of these lamps per mile, giving a total illuminating power of 63,000 candles. Under a five years' contract, and no doubt taking into consideration the largeness of the contract as a whole, the Gaslight and Coke Company's price for 3000-candle power units in Westminster was £22 per annum. The £634 would allow of 29 of these 3000-candle power lamps to be supplied per mile; and these would represent 87,000 candles. What about Alderman Vorley's 48,664 candles in comparison with a rational basis? We hope for the future that he will compare things that are comparable, and not be misled into the opposite course. As to the £131 per mile for the low-pressure lamps, has he failed to note that the new contract with Hackney works out to £74 per mile for inverted incandescent lamps of higher illuminating power than the old vertical type; so that the illuminating power will be greatly increased per mile of street?

It was remarked last week that the long-talked-of promotion in the next session of Parliament to confer upon local authorities wiring and fittings powers was unrepresented by the first formality of a notice in the "London Gazette;" and therefore we presumed that something had happened to cause the idea to be dropped or postponed. The explanation appears to be that the promoters have thought well to have a conference with the electrical contractors, and that conference is still proceeding—*in camerâ*. The parties are as nice and polite to each other as they can possibly be at the present moment. It was not always so. There is no doubt about it that the contractors have the whip-hand; but they have not the capital with which to go into the hire and hire-purchase parts of the business. The promoters, too, of the projected Bill to confer powers, if Parliament think fit (which they have not done in a General Bill up to the present), have no doubt felt it would be a bit irksome to attempt to approach Parliament with municipal opinion so largely divided on the subject of the propriety of extending municipal trading into this highly speculative region. At a meeting of the Committee for the Protection of Electrical Interests the other day, the matter was under guarded discussion; nothing was said about what were the probable terms of agreement over which the two parties will (if they can arrive at that point) shake hands. It is, however, suggested that the outcome may be that the wiring will be left to the contractors; while the municipal authorities will be left to develop the hire and hire-purchase of electrical appliances. There is not much value in discussing probabilities. We must wait and see what is the outcome of the secret conference. The parties may propose, but the municipal authorities will have to obtain statutory powers, and Parliament may dispose of the matter in quite a different way from what is contemplated. At the meeting of the Committee for the Protection of Electrical Interests, the hoary statement was again heard with radiant satisfaction, that, for cooking, electricity at anything like 1d. per unit compares very favourably with gas. That is why the gas cooking stove connection rises in number with graceful ease, while electrical engineers look on from a distance, breaking the tenth commandment with all their might.

The question of consumers' lamps is a very difficult one for electricity supply undertakings, owing to the great expense of the lamps, and the reluctance of consumers to spend the money when renewal is necessary, and when they are not at all sure that they will get the lamp safely to its bayonet joint before there is a collapse of the filament. A writer assuming the *nom de plume* of "Metal," has contributed an article to the "Electrical Review" advocating the supply of electric lamps by electricity undertakings, holding that it is the duty of such undertakings to supply light rather than current. This fact sunk deeply into his mind on receiving the intelligence that a certain large town even now is finding its disconnections of lamps almost equal to the connections, although the current is sold at low rates. It will be remembered that Mr. A. H. Seabrook was saying the other night at the meeting of the Illuminating Engineering Society, that he was only able to retain, on account of the cost, some of his consumers who used metallic filament lamps by getting them to employ Holophane globes and shades, and so enabling the cutting out of some of the points of lighting. What the anonymous writer in our contemporary holds is that electricity stations must furnish lamps to consumers if the best is to be got out of electricity supply. If this be true, the outlook is not all that some of our volatile friends suggest in the electrical press. To undertakings as well as consumers the metallic filament lamps are costly; and the supply of lamps means labour in addition to lamp cost. The point of the article by "Metal" is reached when he describes how he is meeting the situation. In place of a consumer having a cash discount of 5 per cent. on his electricity account, he is supplied with lamps at a cheap rate; the lamp account being subject to a discount of 10 per cent. He is of opinion that this scheme is better than reducing the price of current. That is a debatable point; but "Metal" is satisfied that his lamp-supply scheme has been of advantage to his undertaking. Then comes the inevitable contractor with a letter to our contemporary with his irrepressible complaint that "Metal" is trespassing in his province as a trader in electric lamps.

Writing in the editorial columns of our issue of Nov. 22, under the title of "The Antiquated in Gas Lighting," it was pointed out how much injury was done by the indifference displayed in bringing before influential consumers the latest in the means of realizing efficient and economical gas lighting, and thus giving electricity a better chance. Reference was made to the subject again last week in the final paragraph of the "Memoranda." We have since clipped the following from an electrical paper: "The Board room of the Whitby Guardians is at present supposed to be illuminated with gas. So poorly does the illuminant perform its functions, however, that the Clerk to the Guardians has intimated that, owing to bad light, no work can be done in the room. It is therefore proposed to put in electric light. Plans are to be prepared." We have no doubt the announcement is as highly coloured as it is possible for it to be; but if the Clerk has only just discovered that no work can be done in the room because the light is bad, what has the Clerk been doing that he has not sought the advice of the Gas Company, and had some modern gas-burners put in? That would have been far cheaper than an installation of electricity.

The experimental installations of gas and electric lamps in Gower Street, which are to show the Holborn Council what the Gaslight and Coke Company and the Electric Light Companies

in the area are offering for the new public lighting contract, have been completed, and the comparison begins. From notes that have appeared in the "Memoranda," it will have been seen that the "Electrical Times" thought it their duty to meddle between the Borough Council and the competitors as to the terms of the test; and poor "Meteor" has, in consequence, had a facer in connection with the matter which he accepts as gracefully as he knows how. It will be remembered that the Westminster specification was mauled about in curious fashion, that the angles at which the tests are made under the West-end contract were treated in a manner to suggest that the intelligence of those who were responsible for their selection was microscopical in the eyes of "Meteor," and that the palpable object of the criticism was to get a preferential specification for the electric lamps. It did not seem to cross the mind of "Meteor" that the Westminster and Holborn Councils are the purchasers of the illumination they desire, and that they have the right to dictate the terms that best comprehend their views in the matter. The upshot of the little exhibition of bad humour is that "Meteor" has now been informed that the specification prepared by the Surveyor to the Holborn Borough Council was submitted to the Electric Supply Company who are lighting a section of Gower Street experimentally; that this Company conferred with the other two Companies having statutory powers in Holborn; that every opportunity was given for suggesting amendments; and that the conditions were accepted absolutely. When all parties directly concerned in a matter of this kind are satisfied with the conditions, then it is not the business of other people to interfere. Our friend of the "Electrical Times" may be left to get rid, in the manner he thinks best, of any discomfort he has experienced in having to swallow this particular leek.

GAS AND ELECTRICITY TESTS AT CANTERBURY.

Some little time ago, the Directors of the Canterbury Gas and Water Company threw out a challenge to the Lighting Committee of the Corporation to have a comparative test of electric and gas lighting—each party to fit up its own illuminant. As the challenge was not accepted, the Company undertook to carry out the experiment themselves; and their Engineer (Mr. H. C. Page) accordingly fitted up an installation of gas and electric light side by side in one of their show-room windows. The tests were of special interest to the ratepayers, in view of recent discussions at meetings of the Board of Guardians in regard to the lighting of the Workhouse, and the statement by the Borough Electrical Engineer that electricity would be cheaper than gas.

The results of the tests, which were conducted in full view of the passers-by, were strongly in favour of gas, as shown by the following figures for 180 hours' running—Nov. 25 to Dec. 13:

Gas	1s.	6¾d.
Electricity	3	10¼ (net)
Difference in favour of gas	2s.	3½d.

The price of gas is 2s. 9d. per 1000 cubic feet, and that of electricity 4½d. per unit, less 5 per cent. for cash. The gas-burner used was a 60-candle power incandescent, and the electric lamp was a 50-candle metallic filament. The gas pressure was kept constant during the tests (from 11 a.m. till 11 p.m.); never falling below 30-10ths. That the illuminating power of the gas was better than that of the electric light was clearly shown by the printed matter placed in the window at equal distances from the centre of each light.

The results are published in a prominent advertisement in the "Kentish Observer" for last Thursday, which devotes a leading article to the subject; and opportunity is taken to call attention to the relative effects of gas and electric light on the purity of the air in a properly ventilated room, as set forth in the article by Mr. G. Stanley Cooper which appeared in the "Journal" for the 6th inst. (p. 705). His experiments showed that the net increase in carbonic acid after a three-hours test was 0·132 per cent. in the case of gas, and 0·154 per cent. in that of electric lighting; thus proving that gas burnt under proper conditions promotes ventilation, and is healthier than electric light.

We learn that Mr. Page is continuing his tests with a 110-candle power high-pressure inverted incandescent burner and a 100-candle power Osram lamp. The first twelve hours' run resulted as follows: Gas, 2d.; electricity, 5¼d.—still well in favour of the former. Tests of the two lights carried out in the way described are certainly object-lessons of the highest value, as they are open to public inspection.

The death is announced, at the advanced age of 86 years, of Mr. William Thompson, who had long been connected with the public and commercial life of Blyth. He became a shareholder of the Blyth and Cowpen Gas Company in 1858, was appointed a Director in 1860, and made Chairman of the Company in 1879—a position he filled up to the time of his death. He attended the last meeting of the Directors on the 1st inst. In 1904, the Board presented him with a silver tea and coffee service, on the occasion of his eightieth birthday, and in recognition of his work for the Company.

PHYSICAL SOCIETY'S EXHIBITION.

In accordance with the intimation in the "Journal" last week, the sixth annual exhibition of the Physical Society of London is being held to-day at the Imperial College of Science, South Kensington. Arrangements were made for exhibits by certain firms whose names are known to our readers, among them being the following: The holophane lumeter—a surface brightness photometer which will measure the brightness of any object from the hundredth of a candle-foot up to 100-candle feet power—by Messrs. R. & J. Beck. A bi-meter CO_2 recorder—a new pattern, working on very simple and practical principles, containing no absorbent liquids (the only absorbent material used being lime), and capable of adjustment so as to make as many as 25 analyses per hour—made by the Cambridge Scientific Instrument Company. Messrs. Everett, Edgcumbe, and Co. promised a varied collection of instruments, including a pocket "luxometer" for use either with daylight or with artificial light; a Trotter portable photometer; a portable direct-reading lamp photometer, for the direct measurement of the candle power of incandescent lamps in broad daylight; and a portable photometer bench equipment, comprising the latest form of Trotter-Conroy photometer head, fitted with the Trotter light-filter arrangement. Among the other instruments to be on view were the "Dionic" water-tester, sent by Messrs. Evershed and Vignoles; the Foster fixed-focus radiation pyrometer, by the Foster Instrument Company; the Mahler-Krocker bomb calorimeter, by Messrs. A. Gallenkamp and Co., Limited; the Féry spectrograph, by Messrs. Adam Hilger, Limited; and Mr. Somerville's CS_2 and H_2S test apparatus for gas-works, Mr. Dickenson Gair's and Mr. John Hornby's apparatus for the analysis of gas, and the Wanner optical pyrometer, by Messrs. Townson and Mercer.

IMPROVEMENTS IN THE TREATMENT OF GASES.

It will be remembered that some time ago* we published an illustrated description of new tar-extracting appliances which Professor F. W. Burstall worked out at Birmingham University; and when noticing last week the recent visit of the members of the Midland Junior Gas Engineering Association to the University, it was stated that Professor Burstall then showed in operation some further plants.

One of the devices is to be used in connection with the rotary extractor, which, it may be recalled, is formed by a large number of wires rotating at a high velocity. It is found that water injected into this machine is divided into very fine particles by the beating action of the wires—so fine that the water will travel a considerable distance along the main before it condenses, and carry with it finely-divided tarry matters. To remove this, what is called the "screen" washer is placed immediately on the outlet of the tar-extractor. It consists simply of a short length of pipe, in the centre of which are square openings. At the top of these openings there is a slot formed in a water-pipe, so that the whole of the gas has to pass through a water sheet which is formed by the water falling under a head of 30 to 40 feet. In this manner, the whole of the water and tarry matters are carried away, and the gas issues from the other side free from excess moisture.

Another machine shown in operation cooling some 30,000 cubic feet of gas per hour was what is called a "static" washer—an appliance mainly intended for cooling hot gases. This consists of a rectangular iron box, which is entirely filled with wires. These wires are fixed at their upper ends, and lie at an angle to the stream of gas. On the top of the wires is discharged water, through fine holes or slits; so that the gas, in travelling from one end of the box to the other, is brought into contact with the water lying upon the wires. Under the combined action of the flowing of the gas and the impact of the water, the wires are kept in a constant state of vibration, sufficient to prevent any tar from clogging up into the machine. This apparatus was one of the appliances referred to (and illustrated) in the paper read by Mr. W. H. Johns, at the November meeting of the Midland Junior Gas Engineering Association—see *ante*, p. 495.

We understand that Professor Burstall is now engaged in experimenting on the application of the rotary principle to the direct recovery of ammonia from gases by means of washing with dilute acid; and the plant for this purpose is small, cheap in first cost, and will, if successful, materially alter the present practice of working with the liquors. The acid used will be comparatively weak; and it is not expected that there will be any material alteration in the candle power of the gas owing to the acid absorbing some of the higher hydrocarbons.

As mentioned in the last issue, the Licensees for the whole of Professor Burstall's gas apparatus are Messrs. W. C. Holmes and Co., of Huddersfield.

* See "Journal," Vol. CVII., pp. 818-820.

Mr. George James Brown, a Director of the Folkestone Water-Works Company, whose death was recently reported, left estate valued at £18,428 gross, with net personalty of £16,156.

LIGHTING OF THE CITY OF LONDON.

It will be fresh in the memory of readers of the "Journal" that in the spring of last year the Corporation of London sent a deputation from the Streets Committee to inspect the public lighting in the various cities of the Continent with a view to the improved lighting of the City of London. The deputation visited, among other places, Brussels, Paris, Cologne, Dresden, Munich, and Berlin, and presented the results of their investigations in a lengthy report (given in the "Journal" for July 20), in which they made the following observations and recommendations:

Having very carefully considered the various systems, we are of opinion that the public lighting in the City of London can be materially improved; and we have come to the following conclusions:

(1) That, wherever possible, streets should be lighted by means of centrally hung lamps with lowering gear. This we think particularly important in the City of London where the number of obstructions upon the footways in the form of lamp-posts, bins, letter-boxes, &c., is so large.

(2) That open spaces should be lighted by means of lamps upon standards, fitted with lowering gear.

(3) That high-pressure incandescent gas-lamps with inverted burners should be adopted as the illuminant; but where gas is impracticable, electricity with open arc and flame arc lamps should be installed.

We think, however, before suggesting any drastic alterations in the general lighting of the City, that the Streets Committee should be authorized to arrange for some further experimental lighting of the City thoroughfares; and we recommend accordingly.

The Court of Common Council having agreed to the report, the Streets Committee next invited and received proposals from the Gaslight and Coke Company and the City of London Electric Lighting Company, Limited, to experimentally light various areas of the City by the most improved methods and appliances, having special regard to the terms of the first recommendation as to the lighting of the streets "by means of centrally hung lamps with lowering gear," to obviate the necessity of bringing large tower ladders into crowded thoroughfares to attend to the carboning and maintenance of this special kind of lighting.

Among the proposals of the Gaslight and Coke Company was a scheme of centrally hung high-power gas-lamps fitted with the latest method of gear for drawing the lamps from the centre of the roadway to the fronts of the houses, and lowering them to the footpath for the purpose of cleaning and remantling; the winches being fixed on the walls of the buildings in the side streets for preference, to prevent any obstruction in the main thoroughfares. The lamps were to be fixed, whenever possible, at the intersections of the side streets with the main roads, so as to light both thoroughfares, and extinguish the smaller lamps in the side streets.

Having decided upon the eastern portion of Cannon Street, between Dowgate Hill and King William Street (a length of about 300 yards of street), the Company proceeded to instal compressing plant in one of the arches under the latter thoroughfare, and erect seven centrally hung high-power gas-lamps of 1500-candle power of the Keith-Blackman type, with new pattern lattern; a 6-inch main being specially laid for the purpose, and the gas being compressed to between 70 and 80 inches (water gauge). The height of the lamps is about 26 ft. 6 in. above the centre of the roadway, which is some 50 feet in width; their average distance apart being about 105 feet. Two additional lamps have had to be fixed on posts on refuges at either end of the thoroughfare; making nine lamps in all. The height of the light in the two refuge lamps is about 22 feet. In New Bridge Street, the Company have put up six high-pressure gas-lamps of 1500-candle power on standards without lowering gear. The columns are on the footpath, with one small traffic lamp on the refuge in the roadway; the light being about 16 feet from the ground. The lamps are of the Keith-Blackman type, supplied with gas at about 70 inches (water pressure) from an adjoining compressor-house recently constructed in Tudor Street. The following diagram shows the general arrangement of the central suspension in Cannon Street.

The Company also gave a demonstration of low-pressure gas lighting with inverted burners at the western end of Cheapside

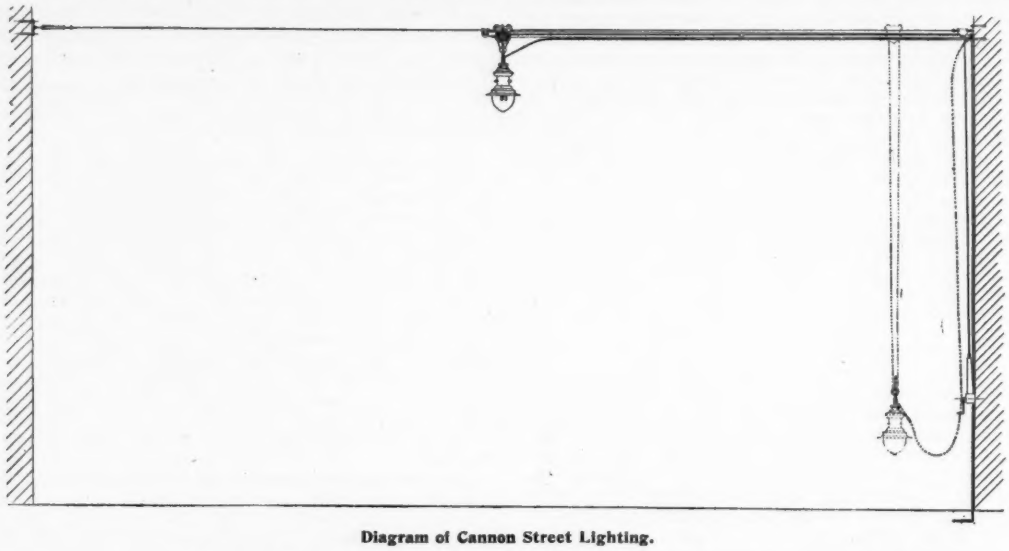
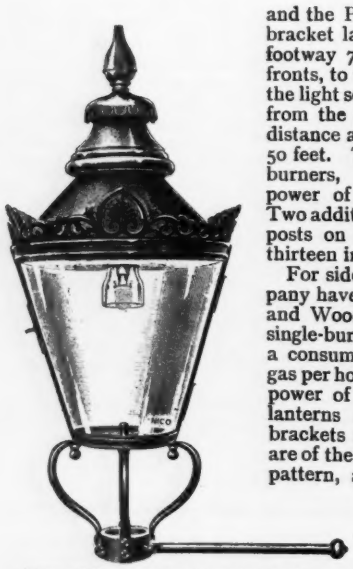


Diagram of Cannon Street Lighting.

and the Poultry, by erecting eleven bracket lamps, suspended over the footway 7 ft. 6 in. from the house fronts, to which they are attached; the light sources being about 13 feet from the pavement, at an average distance apart of a little more than 50 feet. The lanterns contain five burners, giving an illuminating power of 375 candles per lamp. Two additional lamps are fixed upon posts on the street rests; making thirteen in all.

For side-street lighting, the Company have erected in London Wall and Wood Street 26 low-pressure single-burner inverted lamps, with a consumption of 3½ cubic feet of gas per hour; giving an illuminating power of about 90 candles. The lanterns are fixed principally on brackets on the house fronts, and are of the latest type of the "Nico" pattern, as used in Westminster; being the production of the New Inverted Incandescent Gas-Lamp Company, Limited. In Wood Street, the lamps are of the cylindrical pattern, as shown in the accompanying illustration; while in London Wall they are of the square type. The lamps are about 12 feet above the footpath, and some 90 feet apart; the width of the roadway varying from 25 to 40 feet. The lamps take the place of the upright Kern burner, consuming 4¼ cubic feet of gas per hour.



Type of Lantern used in Wood Street.

Awards at the Buenos Ayres Exhibition.—In the provisional list of awards at the Railway and Land Transport Exhibition at Buenos Ayres, the names of the following firms appear: Messrs. Chance Bros., and Pintsch's Patent Lighting Company, grand prizes; Messrs. Ashmore, Benson, Pease, and Co., Messrs. Henry Pooley and Sons, the Stanton Iron-Works Company, and the Foreign and Colonial Lighting Company, silver medals; and Messrs. Hayward, Tyler, and Co., and Messrs. Thomas Piggott and Co., diplomas of honour.

The "Bamag" Distance Lighter.—We have received from the Distance Lighting Company, of Farringdon Road, an illustrated pamphlet on their "Bamag" patent distance pressure lighters. It opens with a chapter dealing generally with the subject, followed by reports by Herr F. Göhrum, of Stuttgart, and Herr H. Dobert, of Geestemünde, translated from the "Journal für Gasbeleuchtung." There are a large number of well-executed illustrations of the appliance, series of views of the factory in which it is manufactured, and a list of the towns and districts in which it has been installed. Interesting features of Herr Göhrum's article are views of Stuttgart in 1827, showing the oil lighting, and in 1909 and 1910, showing the lighting of the public lamps by torch and the "Bamag" lighter respectively.

INSTITUTION OF GAS ENGINEERS—STANDARD SPECIFICATION FOR THE MANUFACTURE AND TESTING OF RETORT MATERIAL.

The Refractory Materials Committee submit herewith a specification which has been drawn up by a Joint Sub-Committee formed of five representatives elected by the Retort and Fire-Brick Section of the Society of British Gas Industries, and an equal number of the Refractory Materials Committee.

The Sub-Committee appointed Dr. J. W. Mellor, of the Staffordshire County Pottery Laboratory, Stoke-on-Trent, to act as their Technical Adviser.

The specification has been drawn up with as little reference as possible to details of manufacture, in which it is thought those responsible should be allowed considerable freedom to employ any methods or mixtures they think desirable.

It appears that, for resisting the rapid changes of temperature to which retorts are subjected, the material should have an open porous texture, and should at the same time show little expansion or contraction when heated to a high temperature; it being, of course, understood that the fire-clays employed are of a sufficiently refractory character. Investigations have been carried out for the Committee by Dr. Mellor on pieces of representative British and Foreign retort material, for the purpose of ascertaining the porosity and contraction or expansion on heating of the material now being supplied; and the tests relating thereto have been decided upon as the result of these investigations.

It is not suggested that finality has been reached with these tests; those given being less than an average obtained from the best quality material now available, rather than marking any great departure in this respect. This particularly applies to the test for contraction or expansion, which has been placed so low (in deference to the wishes of the manufacturers) that it is thought to be of scarcely sufficient severity to ensure good material.

The tests now specified, however, are rather intended to give a lead to development in these hitherto somewhat neglected features; and it is hoped that they will be interpreted for a little time with some latitude on both sides, as it is confidently expected that if the "grog," or burnt clay, employed be that specified in clause 1, and this material and the finished product be fired at a high temperature, no difficulty will be experienced in obtaining retort material of even a higher standard than that laid down.

The specification for general fire-brick material, blocks, tiles, &c., is now in course of preparation, and will probably be published in the Spring of next year, after which it is proposed to undertake investigations of the thermal conductivity of various kinds of retort material, a quality which is considerably influenced by the texture.

It is intended to revise the specifications, from time to time, as experience shows to be necessary.

The Refractory Materials Committee desire to express their appreciation of the co-operation which they are receiving from the representatives of the manufacturers in this work.

F. J. Bywater, Hon. Sec.

SPECIFICATION.

Constituents.

Clause 1—The retorts or retort tiles shall be made of sufficiently seasoned raw clay and clean burnt clay or "grog." No "grog" shall be used which will pass through a test sieve having 16 meshes to the linear inch.

Chemical Analysis.

Clause 2—A complete chemical analysis of the material is to be provided when required by the engineer (or purchaser), for his personal information only.

Refractoriness.

Clause 3—A piece of the material shall show no signs of fusion when heated to a temperature of not less than Seger cone 28 (about 1630° C.); the heat being increased at the rate of about 50° C. per five minutes, in an oxidizing atmosphere.

[Note.—The new scale of Seger cones printed herein is to be used.]

Surfaces and Texture.

Clause 4—All surfaces shall be reasonably true and free from flaws or winding; and, after burning, no "washing" shall be done without the consent of the engineer (or purchaser). The texture throughout shall be even and regular, containing no holes or flaws, and the "apparent porosity" shall not be less than 18 per cent.

Contraction.

Clause 5—The material shall be evenly burnt throughout, and contain no black core. A test-piece, when heated to a temperature of Seger cone 12, for two hours, shall not show, when cold, more than 1 per cent. contraction or expansion. The test-piece shall be 5 to 6 centimetres long; the ends being ground flat, and the contraction measured by means of Vernier callipers reading to 0·1 m.m.—a suitable mark being made on the test-piece, so that the callipers may be placed in the same position before and after firing.

Inspection and Testing.

Clause 6.—The engineer (or purchaser) or his agreed representative shall have access to the works of the maker at any reasonable time, and shall be at liberty to inspect the manufacture at any stage, and to reject any material which does not conform to the terms of this specification. Pieces may be selected for the purpose of testing, either before or after delivery; but in either case a representative of the maker shall, if he choose, be present when such selection is made, and shall be supplied with a similar piece of the retort material to that taken for the purpose of testing.

If the engineer (or purchaser) and the maker are not prepared to accept each other's tests, they shall agree to submit the samples for testing to an independent authority to be mutually agreed upon; and the engineer (or purchaser) reserves to himself the right, if the material does not conform to the tests laid down in the specification, to reject any or all the material in the consignment from which the test-pieces were taken.

The cost of these independent tests and of any retort lengths or tiles damaged before delivery for obtaining test-pieces, shall be equally divided between the purchaser and the maker if the test proves satisfactory; and if unsatisfactory, such cost, and that for all other subsequent tests required on this account from the same consignment, shall be borne by the makers.

The cost of any tests or of any material damaged for the purpose of obtaining test-pieces after delivery shall be borne by the purchaser in the event of the test being satisfactory, and if unsatisfactory by the manufacturer, in a similar manner to that specified for the tests prior to delivery.

Appendix and Notes.

Constituents.

Clause 1—The sieve to be used is the test-sieve specified by the Institute of Mining and Metallurgy.

Chemical Analysis.

Clause 2—The silica should be determined by two evaporations with an intervening filtration; and the alumina, lime, and magnesia, by two precipitations. The amount of titanic oxide should be indicated, and not confused with alumina and iron. The potash and soda should be separately determined.

Refractoriness.

Clause 3—The Deville furnace, although useful for comparative tests in refractoriness, is not altogether suitable for carrying out those specified in this clause, for which a compressed air-gas furnace of the Méker type, or Hirsch's electric furnace, is recommended. The latter can be obtained from Messrs. Gallenkamps, of London; the former from the Scientific Instrument Company, of Cambridge. The gas-furnace will require an air-pressure of at least 10 lbs. per square inch; and for the electric furnace a current of approximately 90 volts and 90 amps, with a slightly higher voltage at the start, has been found, by means of a carefully standardized Wanner pyrometer, to be sufficient.

Two or more tests are generally required with an unknown material.

A preliminary trial is first made with a piece of the material chipped into the approximate form of a cone. This should be cemented on to a refractory disc or slab with a mixture of alumina and best china clay, together with Seger cones 28, 30, and 32 (small size). These cones are selected because they cover the range of first-grade clays usually employed for retort material. Best china clay fuses between cones 35 and 36; and all British fire-clays fall below this point. If cones 28 and 30 fall, the furnace should be cooled, and the material under investigation examined. If it exhibits no sign of fusion, the trial should be repeated with cones 31, 32, and 33. When cone 32 squats, the piece should be again examined; and if it shows signs of fusion, the trial should be repeated with cones 30, 31, and 32. By this method of approximation, it is possible to decide whether the piece vitrified between cones 30 and 31 or between cones 31 and 32.

Softening Points of Seger Cones.

Cone No.	Cent.	Fahr.	Cone No.	Cent.	Fahr.
022	600	1112	9	1280	2336
021	650	1202	10	1300	2372
020	670	1238	11	1320	2408
019	690	1274	12	1350	2462
018	710	1310	13	1380	2516
017	730	1346	14	1410	2570
016	750	1382	15	1435	2615
015a	790	1454	16	1460	2660
014a	815	1499	17	1480	2696
013a	835	1535	18	1500	2732
012a	855	1571	19	1520	2768
011a	880	1616	20	1530	2786
010a	900	1652	26	1580	2876
09a	920	1688	27	1610	2930
08a	940	1724	28	1630	2966
07a	960	1760	29	1650	3002
06a	980	1796	30	1670	3038
05a	1000	1832	31	1690	3074
04a	1020	1868	32	1710	3110
03a	1040	1904	33	1730	3146
02a	1060	1940	34	1750	3182
01a	1080	1976	35	1770	3218
1a	1100	2012	36	1790	3254
2a	1120	2048	37	1825	3317
3a	1140	2084	38	1850	3362
4a	1160	2120	39	1880	3416
5a	1180	2156	40	1920	3488
6a	1200	2192	41	1960	3560
7	1230	2246	42	2000	3632
8	1250	2282	—	—	—

APPARENT POROSITY.

Clause 4—The "apparent porosity" tells what fraction of the volume of the whole piece is occupied by air-spaces, and is therefore:—

$$\frac{\text{Volume of pores} \times 100}{\text{Volume of piece (including pores).}}$$

This constant can be determined in one of the numerous voluminometers working with the vacuum process. Messrs. Gallenkamp and Co., of London, make a porosimeter which allows of this determination being made as quickly as is consistent with accuracy. The details of working are supplied with the instrument.

LINEAR CONTRACTION OR EXPANSION.

Clause 5—The term "linear contraction or expansion" indicates the percentage change in length (and by a simple calculation the change in volume) which occurs when a piece is fired under the conditions stated. Consequently the linear contraction or expansion is—

$$\frac{\text{Change in length} \times 100}{\text{Original length of piece.}}$$

A carborundum wheel may be used for grinding the ends of the test-pieces flat; and a mark should be made across the slab with a steel file. One of the Méker gas-furnaces, with blast if necessary, may be used for carrying out the test. The temperature is difficult to regulate without a pyrometer. The test-piece should be supported horizontally, and fired along with cones 11, 12, and 13.

[NOTE.—*Any information with regard to the specification may be obtained from the Honorary Secretary of the Refractory Materials Committee, Mr.* F. J. BYWATER, *Saltley Gas-Works, Birmingham.*]

THE GLOVER-WEST VERTICAL RETORTS FOR THORNTON ROAD, BRADFORD.

REFERENCE was made in the last issue of the "JOURNAL" to the fact that the Gas Committee of the Bradford Corporation, on the recommendation of their Engineer, Mr. Charles Wood, had decided to instal the Glover-West system of vertical retorts at their Thornton Road works. The City Council confirmed this decision last Tuesday; and we have since received the following particulars as to the proposed installation, and the illustrations, from West's Gas Improvement Company, Limited.

The contract comprises a plant capable of carbonizing 160 to 180 tons per 24 hours. Two batteries of retort-benches are to be erected, each battery containing four retort-settings, eight retorts in each setting. The new retorts are to be erected, together with a suitable new retort-house building, on a portion of the site occupied by the present retort-houses; and the accompanying block plan illustrates the area which will be occupied by the vertical retorts—the area of the existing plant being shown in dotted lines. The present retort-houses produce approximately 1¾ million cubic feet of gas per day; and the vertical retorts will only occupy about one-third of the site of the existing plant.

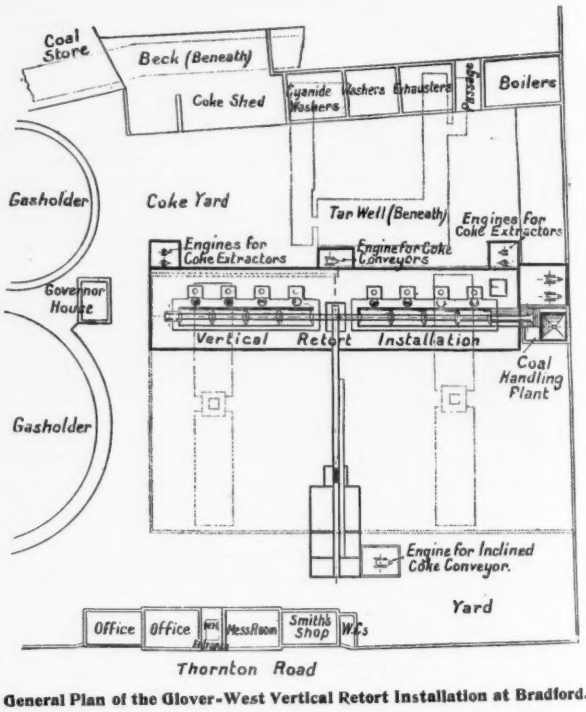
The cross section and the longitudinal views show the proposed arrangement of coal and coke handling machinery. The coal-handling machinery includes an automatic feeder and coal-breaker, with bye-pass for small coal, and a gravity bucket conveyor for delivering the coal into the coal-bunkers. The latter are arranged to contain 48 hours' supply of coal, so that at the week-end it will be unnecessary to resort to wheeling coal from the coal-store when the ordinary daily supply ceases. The coke plant comprises West's coke-conveyors, delivering to the centre of the new retort-house on to a cross-conveyor, which will carry the coke to the storage-hoppers, or to the coke-yard.

The contract comprises the largest installation of vertical retorts ordered so far for this country.

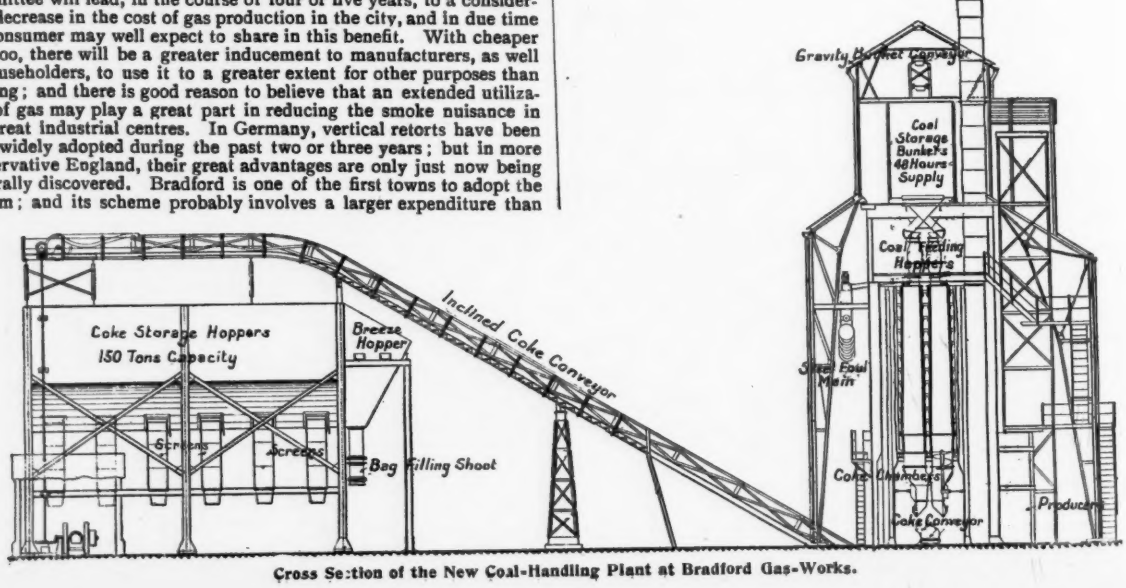
In the course of an article headed "Revolution in Gas Production," the "Yorkshire Observer" says:

The Bradford City Council on Tuesday approved the minutes of the Gas Committee, which recommended that a sum of £31,980 should be expended on an installation of vertical retorts at the Thornton Road Gas-Works. This decision is of considerable interest to all who use gas, and particularly to consumers on a large scale for either power or heating, as it is anticipated that the spirited policy adopted by the Committee will lead, in the course of four or five years, to a considerable decrease in the cost of gas production in the city, and in due time the consumer may well expect to share in this benefit. With cheaper gas, too, there will be a greater inducement to manufacturers, as well as householders, to use it to a greater extent for other purposes than lighting; and there is good reason to believe that an extended utilization of gas may play a great part in reducing the smoke nuisance in our great industrial centres. In Germany, vertical retorts have been very widely adopted during the past two or three years; but in more conservative England, their great advantages are only just now being generally discovered. Bradford is one of the first towns to adopt the system; and its scheme probably involves a larger expenditure than any yet put forward in this country. The Leeds Corporation Gas Committee are at present investigating the matter with a view to the purchase of an experimental installation; and gas authorities in other West Riding towns are watching these developments with considerable interest.

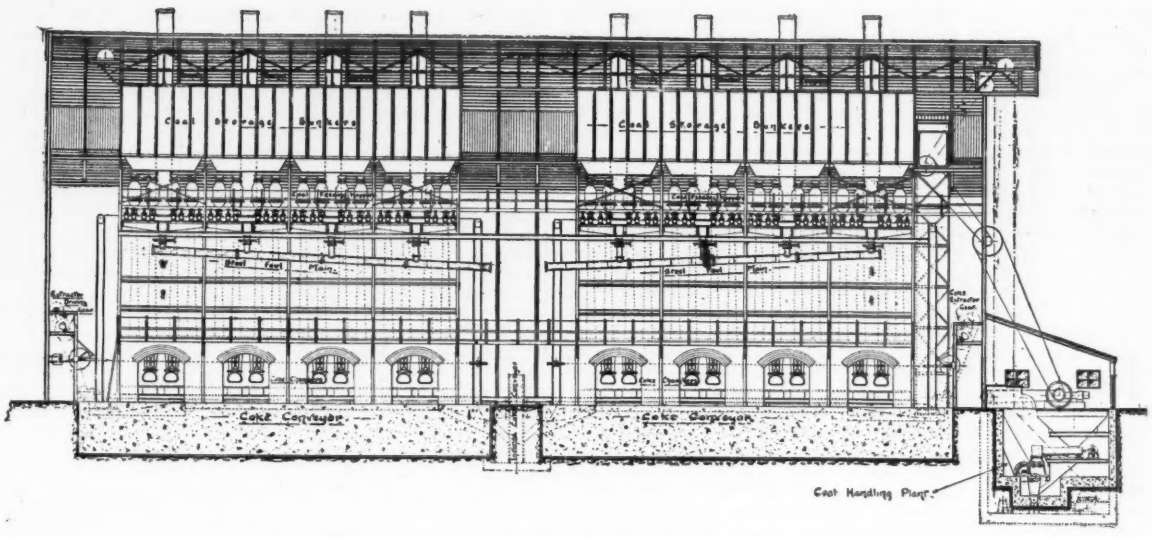
It will be readily understood that the question of cheap production



General Plan of the Glover-West Vertical Retort Installation at Bradford.



Cross Section of the New Coal-Handling Plant at Bradford Gas-Works.



Longitudinal Section of the Glover-West Vertical Retort-House at Bradford.

of gas is one of the most vital which directors of gas companies and the responsible committees of corporations owning gas undertakings have to consider. Unless the consumer can be supplied with gas at a price which will be economically satisfactory, producers will contend in vain against competitors in other fields. These circumstances account for the fact that in no department of the gas industry has more thought been exercised in recent years than in that concerned with the primary operation—the process of carbonizing the coal. Before the era of electrical competition, when the price of gas could be regulated according to the cost of production without much concern as to the possibility of a substitute being adopted by the consumer, there was no urgent need for the exercise of the inventive faculty. When the necessity did arise, however, men were soon found with the capacity to adapt the equipment of gas-works to the requirements of a new and more strenuous era.

The latest development in the design and construction of retorts promises to result in something like a revolution in the industry, so far as cost and efficiency of production are concerned. It is the outcome of investigations and experiments which have been proceeding for some time both in Germany and Great Britain, though the application of the results has been carried very much farther in Germany than here.

Gas committees in all parts of the kingdom are rapidly discovering the great merits of the new system; and though only a few instalments have been put down so far in England, many schemes are in course of preparation for the substitution of vertical for existing horizontal or inclined retorts. Not the least important are the projects which the Leeds and Bradford Corporation Gas Committees have in view. Though the Leeds Committee was the first to turn its attention to vertical retorts, greater dispatch has been shown by Bradford in arriving at a decision. The resolution which the Council adopted on Tuesday provides for a complete installation by an English firm for the Thornton Road works to replace the present plant, which requires extending and renewing.

REFRACTORY MATERIALS AND THEIR TESTING.

By Dr. Rudolf Lessing.

[A Paper read before the Liverpool Engineering Society, Dec. 14.]

The choice of the materials which are employed in the construction of the receptacles and carriers of energy, is one of the most important factors which determine the successful execution of any engineering problem; for however ingenious and promising the design for a certain piece of machinery or apparatus may appear, its final success will largely depend on the absolute suitability of all the materials used in carrying the idea into practice for the specific purpose to which it is put. The study of the properties of building and engineering materials has become a most important science; and with the greater knowledge gained, enormous advances have been made, and are being made, in the application of the new facts and principles discovered. Great strides have been made in the production of metals and alloys, of which the physical properties can be accurately predetermined by giving them a definite chemical composition. One need hardly be reminded of the changes wrought in the methods of building construction by the advent of that peculiar combination "ferro-concrete," and its scientific exploitation.

There is one group of materials, however, the "refractory materials," which, though widely employed in nearly all classes of engineering, have not yet found that recognition as a field of scientific and technical research which they deserve, and which their importance as constructional elements amply justifies. Considering that nearly all the primary energy which is employed in the industries is thermal energy, and that its transformation almost invariably involves the application of high temperatures, it is obvious that materials capable of resisting these temperatures must be used to a greater or smaller extent in every branch of engineering. The fact that the study of refractory materials has not up to now been a very general one, is evidently due to the difficulties of their examination under the conditions under which they are used in practice—at high temperature.

On turning to the dictionary, the general definition for refractory is given as "difficult of fusion." Not specifying a definite range of temperature, this leaves the determination of at least the lower limit to arbitrary judgment. Generally speaking, refractoriness can only be a relative term; and advances lately made in the means of producing very high temperatures—notably by regenerative gas firing and the electric arc—have caused materials up to then regarded as refractory to be looked upon as "readily fusible" at these temperatures, and incidentally made it necessary to improve the properties of the products to meet the new and more stringent demands.

The most important of raw materials which by their chemical composition are particularly capable of withstanding the influence of high temperature, and which at the same time can be moulded or pressed into the required shape, are fire-clay and quartz. There are quite a number of other materials of very highly refractory properties which can be, and are being, used for special purposes. Some of the metallic oxides, such as magnesia and alumina, the latter in its natural state as bauxite, or in artificial form as a bye-product of the thermite treatment (dynamidon), chromium oxide, zirconia carbon, and a number of artifical products of carbon and silicon mixtures, such as carborundum and silundum, all come under this heading. As most of these are only used for special purposes, it will suffice to deal here with the two principal materials named, of which the application by far exceeds in quantity and importance that of all the other materials together. Again, of fire-clay and quartz, the former is of wider application on account of its neutral character, while the latter can only be used where acidity is not injurious, or even where it is required.

All clays are the products of a secondary decomposition of volcanic rocks, such as granite, consisting of conglomerates of quartz, felspar, and mica; this decomposition being caused by the chemical action of water and carbon dioxide, the physical influence of changes of temperature, and possibly mechanical disintegration. According to the original composition of the parent rock, the degree of decomposition or "kaolinization," and the degree to which products soluble in water have been washed out, a clay deposit would contain more or less clay substance (kaolinite), together with the remainder of unattacked rock-particles and chance impurities. The clay substance proper is a hydrated aluminium silicate, $Al_2O_3\ 2SiO_2\ 2H_2O$, holding its water in chemical combination. This water cannot be removed by drying, but only on raising the temperature to a dull red heat.

China clay consists, especially after washing, to a large extent, of pure clay substance. It is extremely refractory, burns to a pure white porous ware, but yields to less pure clays in point of plasticity. Plasticity is the peculiar property of clays to retain, when mixed with a certain quantity of water, any shape given to them, and which is irretrievably lost on burning the clay. The scientific explanation of the cause of the plasticity in clays has been for years the subject of research and controversy; but it seems more than likely that the advances in the knowledge of the chemistry of colloidal bodies will, before long, throw some light on this most intricate problem. As indicated before, the plasticity of the clays depends on their impurities. It may be said that generally the character of a clay is determined by the amount and kind of its impurities. This is more particularly the case as regards refractoriness. The behaviour of the various kinds of clay in this respect differs widely, and is, in general, dependent on their chemical composition.

If chemically pure alumina is exposed on the one hand, and pure silica on the other, to the temperature of fusing platinum—*i.e.*, 1710° C. (3110° Fahr.), the former does not show any signs of

melting, while the latter is partly fused to a transparent, glass-like mass. If a mixture of both substances is then prepared, in the ratio of $1Al_2O_3 : 2SiO_2$, as it exists in pure clay substance, this will show signs of fusion at 1500° C. (2730° Fahr.), the melting-point of iron, and therefore at a temperature below the fusing-point of either of the components. The fusing-point of the mixture is still further lowered by adding more silica than corresponds to the above proportion. By adding to such a mixture substances commonly called fluxes, which always accompany the clays as impurities, the fusing-point is again lowered.

In 1868, Richters found that equivalent quantities of the various fluxes have the same effect in reducing the fusibility of clay. Thus, 40 parts of magnesia (MgO), 56 parts of lime (CaO), 62 parts of soda (Na_2O), 72 parts of ferrous oxide (FeO), 80 parts of ferric oxide $\frac{1}{2}$ (Fe_2O_3), and 94 parts of potash (K_2O), would be of equal value; or, in other words, if equal parts by weight of these substances be added to the mixtures, magnesia with the lowest combining weight would have the strongest, and potash the weakest, effect in the series. Richter's law of the influence of fluxes was tested by Bischof and others. The older researches were made on the assumption that, on fusing, the aluminium silicate of the clay combined with the fluxes, forming double silicates. In the light of modern physical chemistry, it is known that the action of the fluxing agents on clays consists in the formation of solutions, and follows the general law for dilute solutions that an equal number of molecules of different substances, in an equal quantity of solvent, lowers the melting (solidifying) point by equal amounts. A proof of this was given in an exhaustive research by Ludwig, in 1904, who investigated some 80 different clays for this purpose. He demonstrated, on the basis of his analytical results, the connection of chemical composition and fusing-point.

A clay of the following composition may serve as an example.

	Per Cent.		Per Cent.
Al_2O_3	= 38·15	Fe_2O_3	= 0·77
SiO_2	= 47·69	CaO	= 0·21
TiO_2	= 0·12	K_2O	= 1·26

To obtain the proportion of molecules, the percentage figures are divided by the molecular weights.

Al_2O_3	= 38·15 ÷	102	= 0·37402
SiO_2	= 47·69 ÷	60	= 0·79484
TiO_2	= 0·12 ÷	80	= 0·00150
Fe_2O_3	= 0·77 ÷	80	= 0·00963
CaO	= 0·21 ÷	56	= 0·00374
K_2O	= 1·26 ÷	94	= 0·01340

To obtain comparative figures, the value for alumina is reduced to unity by dividing all figures by 0·37402.

Al_2O_3	= 0·37402 ÷	0·37402	= 1
SiO_2	= 0·79484 ÷	0·37402	= 2·125
TiO_2	= 0·00150 ÷	0·37402	= 0·004
Fe_2O_3	= 0·00963 ÷	0·37402	= 0·0257
CaO	= 0·00374 ÷	0·37402	= 0·0100
K_2O	= 0·01340 ÷	0·37402	= 0·0358

The figures for the fluxes obtained are now molecular values; and their sum (F) represents the whole fluxing influence. The composition of this clay may therefore be summed up thus—

$$Al_2O_3 + 2{\cdot}125\ SiO + 0{\cdot}0755\ F.$$

expressing for purposes of comparison the total composition in two figures.

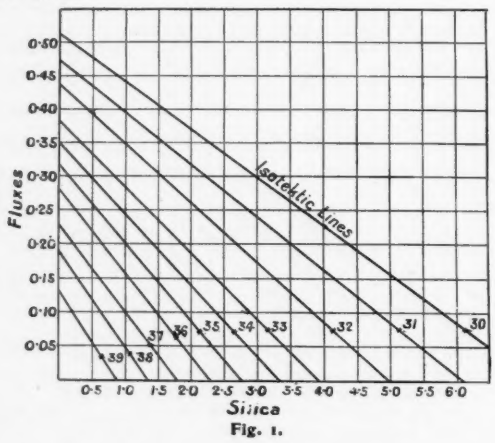


Fig. 1.

On plotting these two figures on a chart (fig. 1), the silica on the abscissæ and the fluxes (for convenience multiplied by 10) on the ordinate, and repeating this for all the clays analyzed, as well as for artificial mixtures of equal fusibility, Ludwig found that clays of equal fusing-point occupy "isotectic" lines. If the known composition of Seger cones, denoting definite temperatures, is calculated in a similar way and entered in the chart, direct comparison with actually determined fusing-points will be possible. The fusing-point of the clay which has been given as an example would correspond to Seger cone 35.

This method may, at first glance, appear somewhat complicated; but it is in fact of extreme simplicity, and offers ready means of expressing analytical results in a useful manner, of indicating the nature of the clay, and of comparing it clearly with others. It may be added that the method seems to apply fairly generally; but it must be understood that the actual melting-point is given, and not the temperature at which incipient fusion takes place. It must further be understood that the knowledge of the chemical composition of a clay makes the actual determination of refractoriness by no means superfluous, as the difference between these two points varies considerably with different clays. On the other hand, this method of expressing results should be abundant evidence to show the usefulness, and even the necessity, of chemical analysis in the examination of clay or clay goods. This analysis should comprise all data required to give the ratio of alumina to silica and to the fluxing agents. It would not do, however, to rely on analytical results only in the examination of refractoriness. The softening or fusing point must be actually determined by experiment; and the behaviour below this point should be observed, since materials differ greatly in respect of the period during which the softening process occurs.

The fusing-point of refractory goods is determined in special furnaces in which the high temperatures required (up to 2000° C.) can be obtained. Among these, the old type originally designed by Deville enjoys a wide application to this date (fig. 2). In it a highly refractory crucible, containing a small piece of the material to be tested, is packed in incandescent retort carbon, which is raised to white heat by air from a pressure-blower. As indicators of the temperature obtained, Seger cones are used. These are little pyramids of varying but still definite composition, the fusing-points of which form a range of temperatures from 600° C. (1112° Fahr.) up to 2000° C. (3632° Fahr.). They were devised by Seger, the founder of the science of ceramics; but their composition has been altered from time to time to bring their accuracy up to date. Two or three of these cones are placed in the crucible, together with the test-piece; and by comparing the state of fusion of the test-piece with that of the cones, the temperature denoted by the cones showing corresponding signs of fusion is taken as the measure of refractoriness.

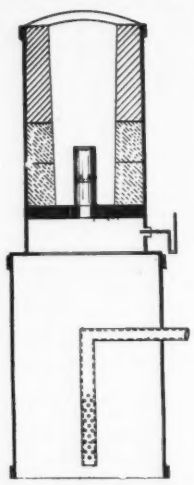


Fig. 2.

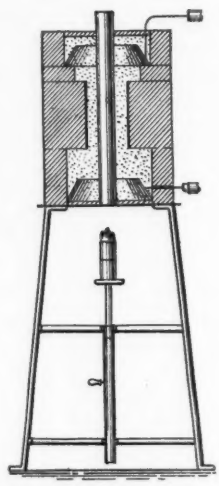


Fig. 3.

Fig. 3 gives a diagrammatic view of a more modern type of furnace—an electric resistance furnace. The high temperature is obtained by passing an electric current through loosely-packed granulated carbon, which surrounds a highly refractory vertical tube. The cones, which need not be protected by a closed crucible, are inserted into this tube by an axial shaft, for raising or lowering with a bayonet fixing attachment. This furnace permits of convenient observation during the whole testing period. It requires a current of 70 to 80 volts and 130 amps.; and the current usually available must be transformed accordingly.

It must not, however, be supposed that the refractoriness (say) of a fire-brick is solely dependent on the fusion-point pure and simple. This rather indicates the extreme temperature up to which it remains solid. Apart from conditions of testing—such as raising the temperature faster or slower, maintaining an oxidizing or reducing atmosphere, &c.—it largely depends on the physical structure of the material. Fusion does not take place suddenly throughout the mass. It commences by the softening of the thinner parts of the granules of which the body is made up. This will liquefy, and attack the inner parts by way of solution. This process is therefore a far more rapid one with very dense bodies than with fairly porous ones—the former offering much more intimate contact. It is consequently possible, by using the same clay, but moulding and burning it in a manner that will ensure a difference in density, to obtain articles which will, for practical purposes at any rate, show quite an appreciable difference in refractoriness.

This consideration leads on to the all-important question of physical texture in refractory materials; for it follows that differences in this respect must have a great influence on their behaviour when in actual use. Fire-clay goods are not generally made of "green" clay only; but a very large proportion of the raw material consists of burnt clay, either specially prepared for this purpose or in the form of broken bricks or blocks. In certain goods, up to two-thirds of the mass is made up of burnt material; the unburnt plastic clay simply serving as a binder before burning.

By crushing the burnt material or "grog" to certain sizes, and carefully grading it, the grain and texture of the goods may be varied and suited to the special purpose. The "grog" forms the skeleton of the refractory body; and the shrinkage, both during the drying and the firing process, depends a good deal on the amount of "grog" incorporated into the plastic clay. Articles which have to stand frequent and rapid changes of temperature should be of coarse grain; and the fine dust obtained on grinding the "grog" should be removed, as it would otherwise fill the interstices between the coarser particles and counteract their good effect. The coarser the grain, the greater the porosity; and the determination of the latter gives a good idea of the density and inner texture.

The principle of the method usually employed for the estimation of porosity is to determine the total "volume" of a test-piece and the volume of the pores or interstices, and to express its porosity as the "ratio" of the volume of the pores to the total volume. Incidentally, knowing the weight of the piece or slab, its "volume weight" and the true specific gravity of the material can be determined.

The apparatus used to advantage by the author is shown in fig. 4. It is a slight modification of similar contrivances devised by Seger and others. The glass vessel, containing about 3 litres of water, or else a suitable light hydrocarbon (*e.g.*, naphtha), is filled up to the two-way stopcock, below the funnel. The tap leading to the graduated tube being open, the level in this tube is read off. A quantity of liquid is then sucked into this tube by means of the rubber tubing, the lid removed, and a test-piece of known weight, which has previously been dried at 110° C., placed in the vessel. The lid is replaced, and the vessel, through the two-way tap, is connected to a good vacuum pump. By this means, the air is removed from the pores, and rises in bubbles to the surface. On opening the vessel again to the atmosphere, the water penetrates into the pores, filling them completely. Connection with the graduated tube is then re-established, and now the increase in volume is equal to the volume occupied by the solid mass of the test-piece. This is then removed from the vessel, the new level taken, and, after wiping the surface, the piece is put back again. The new difference in volume corresponds to the volume of solid mass *plus* pores, and the desired ratio can be directly calculated by dividing the second difference into the first.

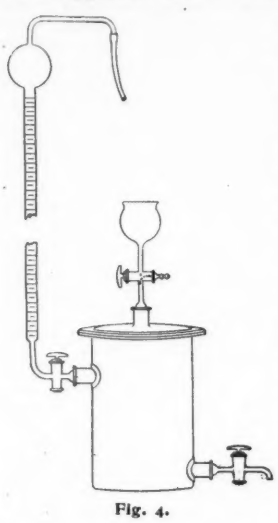


Fig. 4.

$$\text{Porosity} = \frac{\text{Volume of pores}}{\text{Volume of solid mass} + \text{pores.}}$$

From the known absolute weight and either volume, the specific gravity and volume weight may be obtained.

The question of porosity is important, not only in its relation to refractoriness and resistance to changes of temperature, but in various other respects. Where smelting operations are carried out, the material should be dense enough to prevent its getting soaked with the molten metal; but where low heat conductivity is required, a more porous mass will answer best. For special purposes, such as the manufacture of "fuel" for domestic gas-fires or for porous slabs for filtering purposes, the porosity must be artificially increased by adding, before burning, sawdust or other combustible material. On the other hand, higher density—where it is required, as in the case of bricks, which have to stand high compression strains—may be imparted by passing the hand-moulded brick through special presses.

Another most necessary physical test is that for stability of volume, or, as it is more commonly called, for contraction and expansion after heating. In its physical foundation, the property of refractory materials of shrinking or expanding after repeated firing is, to a certain extent, connected with the refractoriness and density, and largely depends on the plasticity of the raw material employed. It may be said that generally fire-clay goods contract and silica goods expand on heating, and that only after being kept at a certain temperature a sufficiently long time do they assume constancy in volume. For the safety of structures, it is therefore of the utmost importance that the material should not alter its volume unduly or irregularly; and the maximum percentage of linear contraction or expansion should be tested for. This is done by exposing a test-slab, with two sides ground parallel, to a definite temperature for a definite period of time, and taking the measurements between two marks by means of a micrometer gauge before and after heating.

Due regard should be paid not only to the physical but also to the chemical behaviour of the material. For in many cases chemical actions combine with the physical influences in the destruction of refractoriness. The most common of these is the action of ashes and flue-dust, which form slag with the acid constituents. Clays differ widely in this respect, and a careful selection must be made for each particular purpose. Where chemical operations are carried out, as in steel furnaces, Bessemer converters, glass furnaces, electric furnaces, in various parts of the blast-furnace, &c., the special circumstances must be taken into consideration. It is hardly necessary to dwell on the necessity of selecting acid, basic, or neutral material where required.

The question now arises as to which points manufacturers should aim at in the production of their ware. To answer this question satisfactorily, the purpose to which the material is to be put must be known and taken into consideration. High porosity tends to make for high refractoriness—which, of course, depends on the raw material in the first instance—and imparts to the material the power of resistance to frequent and rapid changes of temperature. High density, on the other hand, increases its mechanical strength and obviously its thermal conductivity.

A setting of retorts for coal-gas making offers an example for the various demands refractory materials have to satisfy. The arches and walls of the combustion chamber have to withstand the highest temperature of the producer-gas flame—cutting heat which asks principally for high refractoriness. No considerable changes of temperature occur during the working of the setting. Silica bricks, or the peculiar refractory sand found at Ewell, near Epsom, are here used to advantage. They should be fairly porous and non-conducting, in order to concentrate the heat upon the retorts, and should not slag on contact with flue-dust. The division-walls of the settings need not be so highly refractory, as, in properly-designed settings, they are not in direct contact with the flame. They should be of great mechanical strength, having to bear the whole burden of the superstructure. The regenerator blocks have not to stand very high temperatures, and may therefore be of fairly close texture, which, on account of the conductivity, gives the additional advantage of a ready exchange of heat. The producer lining must be chosen largely with a view to its resistance to the slagging action of the ashes and clinker; for the inorganic constituents of the coke belong largely to the class of "fluxes" following the laws explained before. The outer walls of the setting are mostly also built of fire-brick. The author ventures to suggest that for this purpose ordinary building bricks of high porosity and low thermal conductivity should be more generally used, in order to reduce, as far as possible, losses by radiation to the atmosphere of the retort-house.

Attention should be paid to the mortar which is used for building the setting. It must, of course, be as refractory as the bricks and blocks which it has to cement together, and must satisfy all the requirements of these. It should be a good binding agent when applied, and should burn to a neat and long-lasting joint. How important a factor this fire-cement may constitute, becomes apparent from some comparative tests which the author has had occasion to carry out recently. Two kinds of fire cement, both made from the same raw material, but prepared in different ways, showed remarkable difference in linear contraction, amounting in the case of air and fire shrinkage to about 40 per cent. and 30 per cent. respectively.

As to the retorts themselves, they should comprise all the good qualities enumerated above, and none of the evil qualities of the other materials. They should be highly refractory, as they are enveloped in the flame, and should not expand or contract, since they are rigidly fixed in the setting, and are fitted with iron mouthpieces, the joint of which should never leak. They must be capable of suffering rapid changes of temperature, since every few hours they receive a fresh charge of up to half-a-ton or more of cold coal. The difference in temperature, before discharging and after recharging, may amount to 600° C. (1100° Fahr.). This requires a very robust texture and high porosity. They should be good carriers of heat, and transfer it speedily, and without loss, to their charge. This, again, would call for well-conducting material of close texture, which would also answer the further demand for gas tightness; for the walls should not allow any coal gas to pass from, or combustion gases to pass into, the retort. They should further be strong enough to stand any assault from the rake of a burly stoker or the ram of a modern charging-machine. Their outside should not allow any flue-dust to collect and form a non-conducting coating, and they should, finally, have a life of something like 2000 working days without getting unduly cracked.

It is obvious that an article of so complicated a manufacture as a gas-retort cannot be ideal in every one of these points without thereby failing in another direction. The manufacturer must therefore, if he wishes to supply a satisfactory article, compromise all these requirements; and the engineer using the appliances will have to decide, on the strength of carefully dissected statistics, to what extent one of these requirements should be enforced, and another be foregone, in order to produce the most profitable result from a commercial point of view.

In this connection, it is gratifying to be able to record an instance of industrial co-operation between manufacturers and users of a class of products which should be calculated to produce most beneficial results in the near future. The gas industry depends to a very large extent on the employment of refractory materials for the primary separation of the gaseous constituents from coal—the most important step in the whole series of operations carried out in a gas-works, for the old saying that "Dividends are made or lost in the retort-house" has come to be regarded by the profession as almost an axiom.

Realizing the importance which must be attached to the plant and material which constitutes the greater part of the capital

outlay of any gas undertaking, the Institution of Gas Engineers have taken the lead in an endeavour to investigate and improve the quality of refractory material used for the purposes of the industries, and the conditions of its employment. With this object in view, they have formed a Special Committee whose work has already, after a comparatively short time, borne fruit. First, material was collected from a number of works as to the average conditions under which refractory materials are being used. Then manufacturers were approached, and the Fire-Clay Section of the Society of British Gas Industries readily came forward; and, by mutual consent, a Joint Committee was formed with a view to drawing up standard specifications for the materials to be supplied.*

One of the first results of this hearty co-operation between seller and purchaser is that the manufacturer is informed of the requirements his article has to satisfy, and he is in a position to take the steps necessary to achieve this object. The user of the article, on the other hand, will test more closely the quality of the goods supplied. At the same time he is forced to pay more attention to the circumstances under which he employs the ware. Such co-operation must of necessity be of mutual benefit, and should prove a most important factor in the development of an industry. In other industries—as in the iron and steel trade—preliminary steps have been taken to set a similar movement on foot; and it is to be hoped that it will be accompanied by a similar success, and that it will serve to promote the progress and welfare of the industries concerned.

* The report and specification here referred to were issued last week, after Dr. Lessing's paper had been read. They appear to-day in the "JOURNAL," *ante*, p. 839.—ED. J.G.L.

YORKSHIRE JUNIOR GAS ASSOCIATION.

Conferences on technical matters often yield their most fruitful results from the informal gatherings and conversations that occur in the intervals of the reported proceedings. Probably this holds good in nearly all gatherings; but with few is it so emphatically true as with the Junior Gas Associations. Most of these now recognize this, and provide occasional informal and private meetings, in which information is freely asked for, experiences are exchanged, and incidents recited that are hardly meant for full publicity. Experiences with consumers and their complaints, with work done by gas-fitters, plumbers, &c., and with sudden emergencies, and how these were dealt with, suggest themselves at once as topics of this kind.

The Yorkshire Junior Gas Association held such a meeting on Saturday at the Leeds Institute, under the chairmanship of Mr. F. Scholefield, the President. A large attendance of members, who followed with close interest an animated and well-maintained discussion, justified the form of the meeting and the choice of subjects, and afforded gratifying testimony to the success of the openers' efforts. Mr. C. D. Cawthra, of Halifax, gave a very interesting and well-written paper on certain "Gas-Works Emergencies" in which he had been concerned. The paper amply merited preservation in permanent form in the printed proceedings, both for the sake of the subject-matter and its treatment. Still, it was thought best to adhere to the general rule of privacy for such subjects as breakdowns and emergencies.

One of the most gratifying features of the work of the Junior Associations has been the evidence they have afforded that the members may be fully trusted to exercise a wise discretion as to what they venture to tell of their experiences and the methods of the works they are connected with. Fears sometimes expressed on this score some years ago have been laid to rest; and those who know most of the working and proceedings of these Associations are most proud of the tactfulness and trustworthiness of the speakers, and of the *esprit de corps* manifested in the welfare of the gas undertakings with which they are connected. On the present occasion, even in the privacy of an unreported meeting, nothing was told or said that might not with perfect propriety have been fully communicated to the Press.

Mr. R. Halkett, of Leeds, followed with "Remarks on the Organization of the Outside Department," a subject he has made peculiarly his own, and on which he is always heard with interest. To the vigorous discussion that followed, Mr. W. Hole, the Superintendent of the Leeds Outside Department, contributed a warmly welcomed and characteristically helpful speech.

Advertising Gas.—The general public are still being kept informed on the subject of the advantages and capabilities of gas by means of well-written articles in local papers in different parts of the country. To some of these attention has already been called; and two which appeared last week in Mancheser deserve notice. On Wednesday, the "Courier" contained an article on "How to Combine Powerful Lighting with Economy," by "A Gas Expert;" while "The Comfort of Gas" was the subject of another in the "Guardian" on Friday. They are both written in popular style, suitable for the ordinary reader, who has only to look at the advertisements accompanying the articles to find how and where he can procure both the "comfort" and the "economy" he is assured are so easy of attainment.

GAS FOR INDUSTIAL PURPOSES.

By L. F. TOOTH, of the Commercial Gas Company.

[An Address to the London and Southern District Junior Gas Association, Dec. 16.]

For my address I have chosen the application of gas for industrial purposes, with special reference to metal smelting. I am convinced that gas undertakings in manufacturing districts are on the eve of a field of supply unparalleled by any previous introduction. Having the good fortune to serve the Commercial Gas Company, whose area of supply is largely one of a manufacturing character, it enables one to obtain a knowledge of the conditions and methods of many industries, and how to adapt gas to any particular requirement.

There are two methods of application—viz., gas by pressure or the bunsen flame, and gas by air pressure or the blow-pipe flame. In my early experiments, I observed that furnaces fired with gas by air pressure behaved in a most erratic manner; there being continual variations of temperature, and incomplete combustion. In obtaining a certain result, the time has been found to vary more than 100 per cent. As constant temperature and time, apart from cost, are of the utmost importance in all furnace work—particularly in the melting of precious metals—many difficulties arose. Employing a series of high-pressure bunsen burners, instead of one air-pressure burner, good results were obtained; but the attention, manipulation, and upkeep would not render this system commercial. Not being successful in obtaining a high-pressure gas-burner to deal with a volume of gas of (say) 500 to 600 cubic feet, and to give the same flame temperature as one with compressed air, I devised a burner on which the results of metal melting, given later, are based.

I now propose making a few remarks upon the relative merits of the two systems. In ordinary conditions of gas supply, it is impossible to keep the density, calorific value, and pressure absolutely uniform. The proportion of air for combustion depends upon the composition or pressure. With air pressure burners, both gas and air require regulation; and when a furnace is working, I fail to see how even the most skilled workman can adjust minutely, or judge the colour of flame from the intensity of the furnace. At very high heats, owing to expansion, an increased supply of air for combustion is required; and repeatedly temperature falls owing to an excess of air being admitted to the burner. In processes where varied or increasing temperatures are required, the difficulties in regulation may well be imagined. With the high-pressure gas-burner, I find that the difficulties I have just mentioned are overcome. For example, to increase or decrease the temperature of a furnace, the operator need only adjust the gas pressure by a valve, without alteration to the air supply of the burner, and can do so to an extent of 30° per cent. from any given temperature. On the other hand, a constant and even temperature can be maintained throughout the whole day within 5° C., with a minimum of attention.

A large number of tests were carried out—the temperatures being taken by means of a pyrometer; and complete control was obtained in a furnace, up to 1400° C., by the manipulation of pressure only. Beyond this temperature, a larger volume of air for combustion is required (due to expansion); this being drawn into the furnace by opening a flue-valve—in other words, increasing the draught. In the possible event of a change in the composition of the gas, this is also dealt with by an increase or decrease of pressure, as the case may be.

The maximum temperature of a furnace fired by high-pressure gas has not been determined absolutely, as the pyrometer at disposal, with a thermo-couple junction, only registers up to 1600° C.; and Seger cones are very difficult to place in position at a blinding white heat of over 1700° C., such as is required for the melting of nickel.

In research work of this description, the pyrometer is invaluable, and will be more so when a reliable instrument can be obtained to record higher temperatures. Efforts are now being made to supply much cheaper pyrometers; and when these have achieved success, the pyrometer will come into universal use. In placing pyrometers in position in a gas-fired furnace, care should be taken not to put the point of the thermo-couple junction in the flame, as this would mean a record of flame temperature, and not furnace temperature. The subject of pyrometry has recently been dealt with at length by Mr. C. R. Darling, before the Society of Arts; and I would recommend those interested to consult the Society's "Journal" when Mr. Darling's lectures appear.

In the early stages of my experiments, furnaces were built to a given size; and immediately the pot was inserted, the temperature fell, leading me to think that the furnace was too small for this size of pot. Even after reversing the order of things, this proved not to be the case; but the contact of the flame with the furnace-walls and pot-surfaces acted as a reducing agent to combustion. This led me to build a furnace in which flame contact did not, to any great extent, exist. In order to illustrate this point, the pyrometer tests are indicated on Chart No. 1, where the broken line shows temperatures with surface contact, the full line temperatures with the flame not in surface contact.

In furnaces for metal-melting, better results are obtained by entering the burner on the side, at a tangent. The outlet of the flue should be placed about one-sixth of the circumference at the top of the furnace past the burner entrance; the suction at that

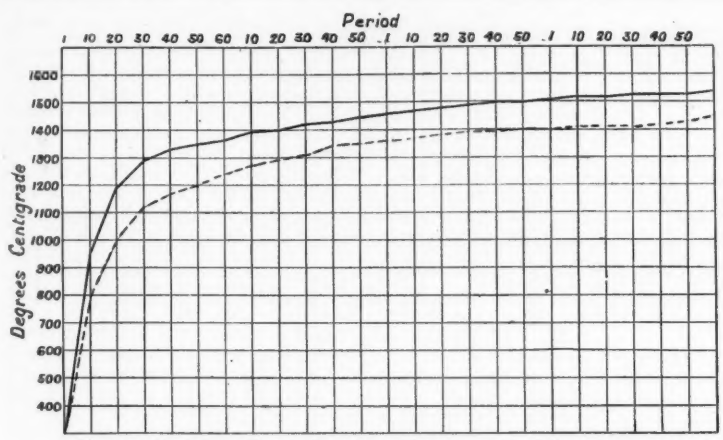


Chart 1.—Pyrometer Tests. Ten-Minute Readings. Four Hours' Duration.
Broken Line—Flame in Surface Contact. Full Line—Flame not in Surface Contact.

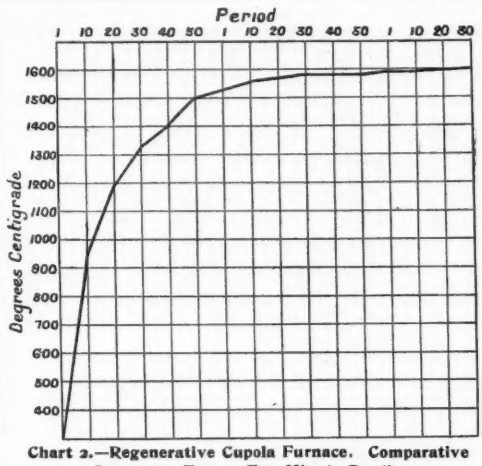


Chart 2.—Regenerative Cupola Furnace. Comparative Pyrometer Tests. Ten-Minute Readings.

point assisting the flame to complete its cycle. When very high temperatures are required, it is advisable to use fire-bricks of the most refractory nature; also cupola furnaces should be lined with ganister or magnite, as this not only prevents the surface of the bricks running into a molten state, but gathers the heat more readily. The outer wall of the furnace should be packed with 3 to 4 inches of slag wool, and should be sheet-iron bound.

Chart No. 2 shows the advantages gained in increasing temperature by regeneration, as compared with Chart No. 1. In this particular furnace, when at over 1600° C., the flue temperature is only 450° C., and the sheet-iron casing just warm.

With reference to practical applications, I am enabled to give some comparative figures for coke and gas firing in brass foundries. The figures for coke are obtained from brassfounders and manufacturers in various parts of the country, who have in use the ordinary draught pit-furnace. Those for gas are obtained from actual working conditions at the works of the Commercial Gas Company, where we have a small foundry, making our own castings, not only for gas-fittings, but for many other purposes. These are not laboratory figures, but actual commercial results. The table shows gas has the advantage from beginning to end.

The number ot charges by coke are less, owing to the continual banking-up of the furnace; and I have taken the maximum output per day by this system. The weight of metal melted per furnace entails, in the case of gas, less capital cost. It will be seen that first heating takes much less time in the case of the gas-furnace, which is an important advantage, and prevents moulders having to wait for metal. The space occupied for the storing of fuel presents a further advantage; and, apart from labour, there is a saving in the cost of tools for firing. The cost of metal melted needs no remark, beyond this—that it can be materially reduced, as it is possible, in a nine hours' day, to turn out eleven melts, if desired. The longer life of the pots should also be considered. The price of these being 6s. 9d. each, the average cost per cwt. of metal melted would be 4d. by coke, compared with 3d. by gas This shows a further saving of 1d. per cwt. Cost of repairs would naturally be less for gas; no stoking being required.

With a gas cupola-furnace, a very great drawback in brass foundries is overcome, as in the event of moulds not being ready (which is a common thing), the metal can be kept on the melt, without wasting and burning away, by reducing the pressure only. In the ordinary coke-furnace, this is generally gauged by removing the cover, which is also the method of keeping a constant temperature.

The more modern coke-tilting furnaces deal with larger quantities of metal; but even here the melting cost is in the same ratio in favour of gas.

COMPARATIVE RESULTS IN BRASS FOUNDRY.

	Coke-Fired.	Gas-Fired.
Size of pots	60 lbs.	60 lbs.
No. of charges per day per furnace (9 hours)	5	9
Weight of metal melted per day	300 lbs.	540 lbs.
Time of first heat	1½–2 hours	1 hour
Time of subsequent heats (average)	¾–1 hour	½ hour
Fuel used per day	2½ cwt.	1780 cubic feet
Price of fuel (gas includes cost of compression)	11d. per cwt.	1s. 11d. per 1000 c. ft.
Total cost of fuel	2s. 3½d.	3s. 5d.
Cost of labour for fireman	1s.	*nil*
Cost of metal melted	1s. 2·6d. per cwt.	8·4d. per cwt.
Average life of pots (charges)	30	39
Cost of repairs (twelve months)	£2–£3	£1 10s.

The following table, showing the various metals that can be melted by gas, may prove of interest. Each individual metal was placed in the furnace when at the temperature of the respective melting-points. The time required to reach the necessary temperature can be calculated from Chart No. 2.

Material.	Weight of Charge. Pounds.	Time. Minutes.	Gas Consumed. Cubic Feet.	Cubic Feet of Gas Per Pound.	Cost per Cwt.	Melting Point. ° C.	Required Temperature of Furnace. ° C.	Pressure in Inches of Mercury.
Lead	100	4	28	0·28	0·7d.	326	500	10
White metal	60	5	30	0·5	1·2d.	420	650	10
Aluminium	63	30	174	2·8	7·1d.	628	750 to 800	12
Glass	64	40	235	3·6	9·2d.	1,100	1,450	14
Brass	60	28	168	2·8	7·1d.	900	1,340	14
Gun metal	60	34	192	3·2	8·2d.	1,000	1,400	14
Copper	60	40	224	3·7	9·5d.	1,054	1,420	14
Cast-iron	56	59	350	6·6	16·9d.	1,075	1,450	14
Nickel	40	150	1230	30·7	6s. 7d.	1,550	1,750	24
Silver	720 oz.	30	176	2·9	7·2d.	954	1,380	14
Gold	720 oz.	38	215	3·6	9·2d.	1,045	1,415	14

The cost of fuel per cwt. of metal melted, with charges in excess of the weights stated in the table, can be reduced by upwards of 33 per cent. The pressure for reducing lead and white metal rapidly is 10 inches mercury. When desired to retain in a molten state for use, the pressure should be reduced to 3 inches mercury. The figures for glass are not as they would appear commercially. This method of reducing should be looked upon as a point of interest only. I am of opinion that, in a suitable furnace, glass can be reduced in quantities of 5 to 10 cwt., as is usual, at much less cost than with coke. I estimate the figure for keeping glass in a working molten state at less than 6d. per cwt.; and I hope, before very long, to realize my expectation.

Aluminium is a metal with a specific gravity of 2·56; being one-third that of brass. The cost per cwt. is not in the same proportion, owing to the increased capacity required for the same weight of metal. If you will refer back to lead, this is the reverse; the specific gravity being 11·37. Brass, gun-metal, and copper, being composed of similar metals, the cost of reducing is in ratio to the melting-point. Cast iron from the pig contains about 10 per cent. of foreign substance, known as slag; and this increases the cost of reduction. Nickel being a metal of high melting-point (upon which authorities differ), requiring practically the maximum temperature at present obtained in a gas-fired furnace, the reducing cost is considerably in excess of other metals in proportion. Even so, the use of gas is commercial, as there are many difficulties experienced with coke-fired furnaces for this purpose. The figures given in the table are for nickel of 99·99 per cent. purity. The difficulties in nickel-melting may be understood by reference to Chart No. 2, showing how gradually the temperature increases after 1550° C. In the event of gas being adopted for the melting of nickel, this country may reap a benefit, as, owing to the difficulties mentioned, and the excessive cost of reducing, the whole of the rolled nickel is now imported from abroad.

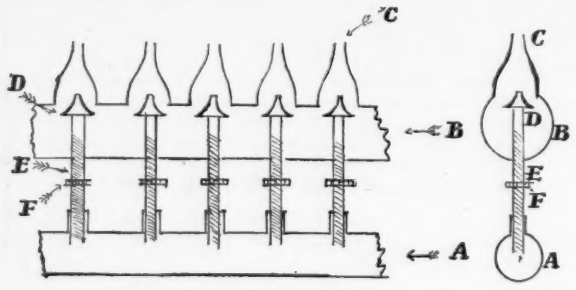
The figures quoted for silver and gold are obtained from outside sources, as I am not fortunate enough to have an outlet for precious metals. But they may be taken as correct, as the melting compares with other metals; hence the consistent result. In reducing precious metals, gas has been a huge success, as the volatilization is reduced to a minimum. Hence the recovery is less costly. In refineries, the recovery by distillation amounts to many thousands of pounds. This illustrates the absolute necessity of constant temperature and regular heats.

In shipbuilding and repairing, a small muffle or open-hearth furnace can be supplied with gas from shore by flexible tube for the purpose of rivet heating, instead of the old method of throwing the heated rivet from the dockside to the ship, or temporary

furnaces can easily be built for plate, bar, or stanchion bending. Also brazing tubes, jointing, &c., can be dealt with on the spot. The heating of large steel plates, ¾-inch thick, for pressing into any desired shape by hydraulic power, is an application that is proving most successful.

For enamelling and japanning purposes, gas has a very big future. I have a few samples of tin-plates printed by lithography and then baked in high-pressure gas-ovens at a temperature of 300° to 350° Fahr. As many as 490 tin-plate sheets are baked in 15 minutes, for the fixing of each colour, for a consumption of 25 cubic feet. I have also a further interesting process of shell finish. The plain tin-plates are placed over a series of very fine bunsen jets, causing the coating of tin to become molten; then immediately immersed in acids, which fixes the wavy or crystallized appearance of the metal. The plates are afterwards coloured, varnished, and baked.

In the recovery of useful material from rubbish, gas plays its part. Pure tin from old pots and cans is removed by a series of burners playing on a perforated cylindrical drum revolving obliquely inside a square casing; the tin afterwards being removed from the refuse that has fallen through the perforations on to the floor of the casing. About 5 tons of this old material is treated and passed through the furnace in an hour.



A.—High Pressure Gas Supply.
B.—Air Supply, drawn in at each end by gas pressure.
C.—Ignition Point.
D.—Regulation of Air Supply.
E.—Longscrew Coupling.
F.—Locking Nut.

Furnace Burner for the Recovery of Tin from Old Material.

I have some interesting specimens of photographic process work, and have brought them to your notice to illustrate that uniform temperature and perfect heating surface can be obtained in a high-pressure gas-furnace, and work of a most delicate nature performed. The picture or pattern is first impressed on to a sheet of opal glass, and placed in a muffle furnace specially constructed, with a top crown heating surface. The temperature required to bake the impression is 50° Fahr. less than the melting-point of glass; so you can imagine that this requires to be very carefully and delicately manipulated. There is also an appliance here for polishing and stretching to shape bottle sealing wax. The flames play on ordinary grilled frets placed on either side; the heat being deflected to the wax held through the opening.

The uses of gas in various industrial processes appear to me unlimited; and I feel sure that coke and other solid fuels have a very short life generally—the advantages of gas being so numerous that they cannot be overlooked by a progressive manufacturer. The immediate readiness, and greater rapidity of gas, the saving in the cost of fuel, labour, space, establishment charges, and upkeep, will bring us nearer the ideal conditions now sought after—smoke and dust abatement, and reduction in coal consumption. Should the order of things rapidly change, as it has every appearance of doing, we must look for competition from producer gas and oil. But each of these has disadvantages, the low calorific value of the former requiring greater furnace and flue space, and the constantly changing character of the latter presenting the same difficulty as the compressed-air burner, producing irregular temperatures.

Discussion.

The Hon. Secretary (Mr. S. A. Carpenter, of Mill Hill) said they had listened to an interesting address on a subject of the first importance; and it was now open to discussion.

Mr. S. Adams remarked that he would like to know the price of gas on which the President based his calculations.

Mr. J. G. Clark, referring to the question of regeneration, asked Mr. Tooth if he would explain exactly how regeneration had been brought about, because this could be accomplished in various ways. If they referred to the figures on the charts, they would find that to attain a temperature of 1200° C. the times required were equal with or without regeneration. But for 1400° there was a saving of 30 minutes in favour of regeneration; and for 1500° there was an advantage of 110 minutes. To attain 1600°, they were bound to have regeneration. It was interesting to note that the question of regeneration became of greater importance as one desired to reach the higher temperatures. The President did not, however, tell them the effect of regeneration on the gas consumption. What economy was to be expected in the gas consumption over the full period? That was to say, having attained the required temperature by regeneration, would he maintain it with less gas than would be required without regeneration? Then the President spoke of the tangential heating of crucibles. One of the diagrams showed a distinct advantage in favour of the prevention of flame-contact. Did he have flame-contact when using crucibles? He noticed the President made a remark as to the necessity, in placing a pyrometer in position in a gas-fired furnace, for taking care not to place it in the flame. Again, he would like to ask whether Mr. Tooth had ever made systematic observations on the relations between flame temperature and furnace temperature. As to the baking of impressions on glass, considering that one had to work within a limit of 50° Fahr., to prevent melting of the glass and at the same time to ensure perfect baking, this not only indicated the maintenance of a fairly constant temperature, but of a uniform temperature throughout the furnace, which was a different thing.

Mr. F. C. Briggs remarked that a case came under his notice at one time in which, as far as he remembered, a firm instituted gold smelting by gas, and found afterwards the metal was extremely "short." The only reason that could be given for this was that the sulphur in the gas had affected the gold.

Mr. E. G. Stewart asked what was the opinion of the President with regard to the Féry pyrometer. Alluding to melting metals by gas, he took it that they must use a crucible; and if they were going to melt cast iron by gas, they would want a pretty big crucible for a 4 or 5 ton charge, whereas a cupola did not present any difficulty at all.

Mr. G. R. Bullwinkle pointed out that in the comparative results in a brass foundry, Mr. Tooth put 1s. down as the cost of labour for coke, and nothing for gas. He took it that there would be a number of furnaces, and that there would be men to look after them, so as to see that a constant temperature was maintained. Then as to the item for cost of repairs, did this include new burner parts, which would have to be supplied from time to time?

The President, in reply, said that, of course, where gas could be obtained at 1s. or 1s. 6d. per 1000 cubic feet, there would be a corresponding advantage when compared with London; but at the same time, in districts which were supplied at these prices, it must be remembered that solid fuel also cost much less than in London. As to Mr. Clark's questions regarding regenerative furnaces, he purposely avoided dealing with the construction of the furnaces and of the method by which he prevented flame-contact with the pot surfaces, because the Association would be paying a visit to the Commercial Gas-Works in February, and then they would see the whole thing in operation. For the moment, he was not at liberty to give details. Of course, in the case of running, they required much less consumption of gas to keep up a given heat by regeneration.

Mr. Clark: There is a saving in gas in running a furnace over a long period? That is to say, to maintain a given temperature, the regenerative furnace requires less gas.

The President said to turn out the same amount of work in one day by a non-regenerative furnace, the consumption of gas would be 2650 cubic feet, and in a regenerative furnace 1780 cubic feet. Thus there was, roughly speaking, a saving of 900 cubic feet in favour of the latter. With regard to the question of flame-temperature, he had no definite figures with him. However, in actual working the flame-temperature was about 15 per cent. more than the furnace temperature; and this brought them back to the old theory that 15 per cent. of the flame heat was taken up by the refractory materials. As to keeping the temperature of a furnace constant, it was possible to maintain a furnace a whole day at any one temperature by proper manipulation. Mention had been made of gold that was affected by sulphur from the gas; but if this was so, it would probably not have been pure gold. However, in the melting of precious metals it was usual to have a cover on the pot. The Féry pyrometer was certainly an exceedingly good one. With regard to crucibles and the melting of iron, he did not mean to say that if gas was applied to this purpose crucibles would be used. They would simply employ cupola furnaces as iron founders would do, but adapt them to gas. The cost of labour 1s. under coke was for firing simply—not attention to the furnaces. There was no labour in turning on a gas-valve, which would be undertaken by the moulder. In a foundry there would generally be about five furnaces; and one fireman attended to the lot. Therefore 1s. would be a fifth of his wages. The cost of repairs included burner parts.

Mr. F. G. Barber asked what was the calorific power of the gas.

Mr. Bullwinkle said in the item for price of fuel it was stated that the figure for gas included cost of compression. What proportion of the amount was for compression?

Mr. Adams inquired whether gas was applicable for steel welding.

The President replied that the calorific power of the gas was about 500 B.Th.U. The cost of compression was 0·7d. per 1000 cubic feet. He was afraid steel welding could not be carried out by the bunsen or the blow-pipe flame. It was, of course, possible to do it with oxy-hydrogen.

The proceedings then closed.

It was Mr. William Wallin, of Newcastle-on-Tyne (not Mr. Waddingham, as reported last week), who was transferred from the class of associate member to that of member, at the recent meeting of the Association of Water Engineers.

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They filled one's home with glee,
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LONDON AND SOUTHERN JUNIOR ASSOCIATION.

A Meeting of the London and Southern District Junior Gas Association was held on Friday evening, at the Westminster Technical Institute, Vincent Square, S.W.—Mr. L. F. Tooth, of the Outdoor Department of the Commercial Gas Company (the President), in the chair.

A Vote of Sympathy.

The President, at the opening of the proceedings, remarked that he had a very regrettable announcement to make. Mr. H. Rothwell, a member of the Council, had recently had a fall and broken his thigh. It was during a demonstration in connection with his classes at the Institute that he met with the accident, of which they were all so sorry to hear. In Mr. Rothwell the Council had an energetic member, who never left anything undone in furthering the welfare of the Association.

Mr. F. Ainsworth proposed a vote of sympathy with Mr. Rothwell and his family in their trouble.

This was passed; and it was agreed that a letter should be written embodying the resolution.

The Industrial Applications of Gas.

The Hon. Secretary (Mr. S. A. Carpenter) remarked that those who were interested in the Sales Department were always on the look-out for fresh outlets for gas, and were pleased to have addresses and papers that would be likely to assist them in their search. The President was going to tell them how gas was superseding coke for metal smelting; and it was a subject with which he was well able to deal, as he had lately made many experiments in this direction.

Mr. Tooth then delivered an address on the "Industrial Applications of Gas;" and this, together with a report of the discussion, will be found on p. 844.

Mr. J. G. Clark, at the conclusion of the address, said it was clear that the President had had great experience in the matter with which he had just dealt; and they ought to feel indebted to him for the information he had given them and the specimens shown of apparatus and of work that had been carried out by means of gas in his district. He proposed a hearty vote of thanks to Mr. Tooth.

Mr. Ainsworth, in seconding, remarked that they would have to look in the future for every means they could possibly secure for assisting the consumption of gas; and going into the industrial field was a step in the right direction. A great advantage of gas in this connection was that it could be so easily regulated.

The vote was carried with applause; and Mr. Tooth briefly acknowledged it.

A Presentation.

The President said he had now the most pleasurable duty of the evening to perform—namely, to present to the late President, Mr. Liberty, the following framed resolution which was passed at the annual general meeting on May 27, 1910.

> **The London and Southern District Junior Gas Association desires to record its hearty appreciation of the valuable services rendered by Mr. W. J. Liberty during his presidency for the past two years, and hereby conveys to him its thanks for the interest he has displayed and for the time and energy he has at all times given for the benefit of the members, and especially for the yeoman work he has accomplished in raising the Association to the high standing it has now attained, and is gratified at the increase of membership and the progress that has been made during his tenure of office. The Association thanks him on his retirement from the office of President, which he has filled so admirably, and sincerely trusts that it will still be privileged for many years to come to number him among its members.**

This small token of their appreciation really hardly met the case, because Mr. Liberty's loyal work, and the energy he had displayed during his two years of office, had brought the Association to high-water mark.

Mr. W. J. Liberty thanked the members for the tangible form in which they had given expression to their feelings towards him. During his term of office, he said, he experienced a good deal of pleasure and made a great many friends. With regard to the Association and its growth, he was extremely gratified at the end of his presidency to find there were so many strong members; and if he had wanted any reward, he would have had it when he saw the large number who assembled to hear Dr. Harold G. Colman give his two lectures on "Gaseous Combustion." He had endeavoured, with some little success, to secure additions to the roll of the Association from among men engaged a little outside the London area, so as if possible to somewhat strengthen the manufacturing side. It was an old saying that London people did not put the interest or backbone into a thing that persons from other districts did. He could only put this down to the fact that in London there were so many other attractions, and people led such a busy life. His idea was that if they could broaden the basis of the Association and secure more country members, who perhaps would be less fickle, it would be a good thing. His services would always be at the disposal of the Association, in which he would not cease to take a keen interest.

CONTROLLING THE WORKING OF GAS-WORKS.

By Dr. Knublauch, of Ehrenfeld, Cologne.

The following observations were made by Dr. Knublauch, of Ehrenfeld, Cologne, in the course of a discussion on this subject at the forty-seventh annual meeting of the Mid-Rhenish Association of Gas and Water Engineers in September last—initiated by the paper read by Dr. Karl Bunte, as given in last week's "Journal," p. 785.

He thought that, after his many years' experience, he might contribute something to the discussion of the question of the control of the working of gas-works and the great value of tests in regard to same; and, in particular, he would go somewhat more closely into the economical result which, according to his observations, was attainable.

It must be well known to many of his hearers that, after he had resigned his position at the Municipal Gas and Water Works at Cologne, where he had been engaged for nearly fourteen years, he had conducted in his own laboratory researches on gas and water supply, and for nearly twenty years past had had the chemical supervision of the working of a large number of gas-works in Germany and abroad—in Belgium, England, France, Holland, and Luxembourg. This had given him the opportunity to study various types of apparatus (particularly for the condensation and washing of gas and for the working up of ammoniacal liquor), and to control in a rational manner the quantitative recovery of ammonia.

Unfortunately, it had to be admitted that in a very large number of gas-works, due importance had not been attached to this point, which was a matter which could easily be attained after chemical investigation of the working had been once for all carried out and the simple control apparatus constructed by him had been thereafter used.

The yield of ammonia from different coals varied in a very high degree. He was frequently in the position to determine the yield of gas, coke, tar, ammonia, and benzol according to a laboratory method which he had worked out, and which—a matter of some importance—gave results coinciding with those obtained in working. These investigations related especially to recovery coke-ovens, for which the calculation of the yield according to these figures had been made, showing that differences in the yield of 1:2 and more frequently occurred (for instance) in regard to tar and ammonia. It was particularly important when considering an expenditure of (say) £35,000 to £40,000 for a large battery of ovens, to obtain information as to the products.

Of the many coals, including some non-European, which had passed through his hands, he would only mention that the yield of ammonia in the distillation of coal in horizontal ovens amounted, in pounds of sulphate per ton of coal, for Saar and Lower Silesian coals, approximately to 17·9; for Westphalian coals, to about 22·4; for many Upper Silesian coals, on the average, to 30·2; while most English coals gave very much more ammonia, rising, according to his observations, to as much as 42·6 lbs. of sulphate per ton. The many coals examined by him from different fields in North and South America showed yields varying similarly to those of the German coals, while the Scotch cannel coal produced less ammonia, and the Australian coal—formerly frequently used for the enrichment of gas—less than 4·48 lbs. of sulphate per ton. It might be mentioned that for gas-works which produced concentrated ammoniacal liquor, the weight of ammonia (NH_3) might be found sufficiently exactly by dividing the quantity of sulphate named by 4—thus making it for Saar coals 4·48 lbs. of ammonia per ton, for Westphalian coal 5·6 lbs., and for English coal for the most part appreciably more.

It would be seen from the annual statistics published by the German Association that the quantity of sulphate obtained was frequently very much less than was indicated by these results; and the disadvantage accruing through direct loss of ammonia was often very great. Not uncommonly two-thirds or less of the ammonia formed in the retorts was recovered. If a gas-works having the make of that of the City of Cologne brought on to the market only two-thirds of the ammonia produced, there would ensue, at present prices of ammonia, a fall in net profit of about £4500, as the works must produce approximately 1500 tons of sulphate; while there were also very great indirect disadvantages which would be briefly indicated shortly.

That the yield of ammonia represented could be easily and surely attained had been proved thirty years ago at the Cologne Gas-Works, when, according to annual reports which had been printed and published, 22·22 lbs. of sulphate were recovered per ton of coal in the working year 1879-80, and 22·29 lbs. in 1880-81. This was after the wet purification and the ammonia works had been rationally regulated according to the speaker's chemical control tests. Previously, notwithstanding that the make of gas was only so little as 400 million cubic feet at these works (which were then new), very much ammonia was lost, and the dry purifying material did very little work. The results of recovery coke-ovens also showed that the figures presented for the yield could easily be obtained. In this case the yield was certainly somewhat higher, because, on the one hand, the coal used for coking, though drawn from the same pits, yielded a little more ammonia on distillation, and, on the other hand, the large quantity of water—

viz., 8 to 14 per cent.—which passed into the ovens with the coal increased the production of ammonia. Thus, for instance, the 22·4 lbs. of sulphate per ton of Westphalian gas coal obtained in horizontal retorts corresponded with 24·64 to 26·88 lbs. of sulphate from similar coking coal in coke-ovens.

But that a proper chemical supervision of the working was, in fact, attended by such considerable advantages might be shown by the utterance of the manager of one of the largest gas-works in Belgium, who had told the speaker he was responsible for the works producing the most ammonia of any in Belgium—namely, nearly 22·4 lbs. of sulphate per ton of Westphalian coal.

The direct disadvantage of the loss of ammonia was by no means the only disadvantage, as the incomplete abstraction of the ammonia from the gas resulted in very considerable indirect harm. A great disadvantage connected therewith was that in such cases the purifying material (oxide) contained little prussian blue and very much sulphocyanide, because the cyanogen (hydrogen cyanide) of the gas combined for the most part with sulphur to form sulphocyanide instead of with iron to form ferrocyanide (prussian blue). Thus good spent oxide contained 14 per cent. of prussian blue and only 0·07 per cent. of sulphocyanide, whereas a bad spent oxide contained only 3·4 per cent. of prussian blue and 13·8 per cent. of sulphocyanide.

The gas-works at Cologne had been the first to sell its spent oxide for the prussian blue which it contained. This was in March, 1882, after material containing a high proportion of blue had been produced through the speaker's method of control, and a method of determination of ferrocyanide had been worked out. The material in the year 1882 contained on the average 10 to 12 per cent. of prussian blue on the wet basis, corresponding to 12·5 to 16·3 per cent. on the dry material.

Whereas the spent material up to that time had been a valueless and troublesome bye-product, the receipts obtained from it, after proper chemical supervision of this part of the working had been introduced, suddenly became unprecedentedly high. Consequently in the annual report of the Cologne Gas-Works for the year 1882-83, it was stated that by good apparatus (to which must be added proper working of the apparatus) the dry purification no longer entailed expense but had become a source of income.

In the middle of the Nineties, the price of prussian blue had risen about five-fold; so that in Cologne £5 to £6 were obtained per ton of spent oxide. Further, with imperfect wet purification, the oxide contained a great deal of soluble salts in which were large quantities of ammonia. The particles of iron were enveloped thereby and much less sulphur was absorbed and little prussian blue; so that the oxide produced small receipts and the expenditure on new oxide and on wages was high. Spent oxide containing 10 per cent. of ammonium sulphate was unfortunately not uncommon, and the proportion sometimes reached 28 per cent. Frequently, the loss through ammonia in the oxide was more than was paid for the prussian blue. That the selling of spent oxide according to the amount of nitrogen it contained was an economically unsound proceeding could only be shortly indicated, on account of the limited time at the speaker's disposal. In good spent oxide the nitrogen present was almost solely that equivalent to the prussian blue; and blue, even at low prices, paid best. If the material were contaminated with sulphocyanide and ammonium salts, it was desirable in some cases to sell it according to its content of nitrogen; but the total receipts from the extraction of ammonia prior to the oxide purifiers and the larger proportion of prussian blue thus obtained were appreciably higher when the working was properly controlled. If the manager of a gas-works wished to obtain information as to the state of his wet purification, it would be sufficient at first for him to send a sample of spent purifying material, of which an exhaustive examination would enable the speaker to form an opinion, without instituting experiments on the working, as to whether, or to what extent, the wet purification was proceeding properly and as to the indirect disadvantages which have been indicated. Experiments would naturally have to be carried out if the investigations of the purifying material disclosed faults, with a view to rectifying the latter according to the works' equipment in the particular case.

The view might well be held that small gas-works were not in the position to extract ammonia quantitatively and at the same time to obtain the highest possible return from the dry purification. There was, however, absolutely no ground for this view, provided that when the small gas-works were erected regard was paid to the necessity for complete condensation, and that the washers used were not too large and especially not of large cross-section, if they were of the scrubber or large vessel type. It was better to use at least three small washers in place of two large ones. The speaker had witnessed the mistake of employing only two washers which were too large, when the quantity of clean water necessary for the last scrubber was too small for efficient sprinkling, so that it became essential to supplement it in order not to obtain too dilute liquor.

This last point ought to be kept in view, as well as the complete extraction of ammonia, in order to reduce as far as possible the expenses for carriage in the case of small works and for working up the liquor in the case of large works. For instance, if in one case an ammoniacal liquor contained 1·75 per cent. of ammonia and in another 2·25 per cent., the quantities of water to be handled were in the ratio of 7 : 9; so that the freight charges, or the expenditure for steam and wages in distillation, and for repairs, &c., would amount with the strong liquor to only seven-ninths of the corresponding charges for the dilute liquor.

The concentration attainable naturally depended on the works' apparatus. Frequently, a strong liquor with its attendant advantages could be produced as a result of investigations; but very often liquor that was too concentrated was met with, and this carried with it various disadvantages for the works where it was made.

Special attention was needed in controlling the working-up of the ammoniacal liquor according to which product had to be made—namely, whether sulphate of ammonia, concentrated liquor, or liquor ammoniæ. Frequently there were quite large losses in such cases if two conditions were not implicitly fulfilled. In the first place, the proper proportion of steam to the inflowing liquor should be exactly right, as a needless excess of steam was costly; and, further, the proper quantity of lime had to be added. The latter was frequently assumed to be the same for ammoniacal liquors from different works, though it varied not only according to the proportion of ammonia but also according to the description of coal carbonized and the construction of the liquor-distilling plant. The quantity of lime depended on the non-volatile salts of ammonia, or more correctly on the quantity of ammonia which was present in the part of the apparatus in which the lime was introduced. If the amount of lime added was insufficient, no excess of steam, however great, would be adequate, as the ammonia combined in a non-volatile condition could not be converted into a volatile condition. With apparatus working with direct steam, it could be concluded that if the effluent liquor contained only 0·005 to 0·008 per cent. of non-volatile ammonia further distillation would not result in a profit being obtained from the small increase in ammonia equivalent to the cost of the steam, &c., expended.

If the working was to be controlled from the start by proper chemical regulation, it ought to be constantly kept up to the mark by the simple apparatus constructed by the speaker for the use of those who were not trained as chemists.

It only remained for him to point out that the manager of a gas-works if he did not happen to be versed in gas chemistry, apart from the question of the time at his disposal, was not in a position to regulate the working in the manner indicated. This was the function of a specialist familiar throughout with working, theory, and analysis. He had often heard it said that the condensing plant, and more especially the washers, would not suffice for the complete extraction of the ammonia, while all that was really needed was to change the method of working the existing apparatus on the basis of the results of investigations. At times, gas and liquor were passed quietly together into the middle washer without the liquor taking up any more ammonia; while at a higher temperature, or at a greater velocity, it would give up ammonia again to the gas. The points to be primarily observed were the exclusion of ammoniacal liquor of a certain strength from the washer, the use of liquor of not too great strength at a proper point, the avoidance of mixing clean water with weak liquor, and, above all, thorough condensation, by which more than one-half of the ammonia could be extracted without passing into the washer. It followed that general rules were not applicable to these points, but that each case must be differentiated according to the works' apparatus and the results of the investigation with it.

If he had the management of a gas-works, he would not rest content until, with the assistance of a specialist, he had obtained the yield of ammonia indicated for the particular coal, and at the same time had secured the maximum return from the spent oxide with the lowest possible expenditure on oxide and wages. It was an easy matter to obtain at least 12 per cent. of prussian blue on the damp spent oxide, or about 15 per cent. on the dry material; whereas, unfortunately, materials with only 5 per cent. or even 3 to 4 per cent. occurred, and the majority contained only about 8 per cent. Why should gas-works remain behind recovery coke-ovens, which had been in existence for only some thirty years, in the quantitative recovery of bye-products, especially as the coke-ovens had not to consider the indirect disadvantages on the purifying material? The speaker had often pointed out that for the most part they worked quantitatively. Whether the gas or coke formed the chief source of revenue, in recent years proper attention had been directed from the economical standpoint to the rational recovery of bye-products.

Finally, the speaker drew attention to the exhaustive treatment which had been given to these questions in his lectures and papers which had been published in the "Journal für Gasbeleuchtung." (1) On "Gas Purification and Ammonia Recovery," 1883; (2) On "The Influence of Lime and Other Mineral Substances on the Distillation of Coal" 1887 ("JOURNAL" Vol. L., p., 411); (3) On "Nitrogen and the Nitrogen Products Derived from Coal," 1895 ("JOURNAL," Vol. LXVI., pp. 1242, 1294).

Society of Engineers (Incorporated).—At the first annual general meeting of the Society, held on Monday last week, the result of the postal ballot for the election of Council and officers for the ensuing year was announced. The new President is Mr. F. G. Bloyd; one of the Vice-Presidents is Mr. Arthur Valon; and among the members of the Council are Mr. Percy Griffith, Mr. T. E. Bower, and Mr. H. P. Maybury. The Chairman (Mr. Diogo A. Symons, M.Inst.C.E., the outgoing President) presented the report of the Council, which showed that the formation of the Society, by the amalgamation of the Society of Engineers and the Civil and Mechanical Engineers' Society, had been fully justified by the success of the first year's work.

MANCHESTER JUNIOR GAS ASSOCIATION.

Visit to the Southport Gas-Works.

At the invitation of Mr. John Bond, the Corporation Gas Engineer, about fifty members of the Manchester and District Junior Gas Association inspected the Southport Gas-Works on Saturday afternoon. The party included Mr. F. Thorp, the President, and Mr. J. Alsop, the Hon. Secretary.

On arriving at the works, the members of the party were received by Mr. Bond and his staff. A visit was first paid to the fine laboratories; and before leaving this portion of the works, Mr. Bond explained at length the thermopile he had built up there for determining radiant heat; also other special apparatus for ascertaining the radiant energy of gas-fires, &c. He described the radiation of light; and the members of the party had an opportunity of comparing by means of the spectroscope the light of an electric flame arc lamp with that given by an incandescent gas-light.

Following the inspection of the laboratories, the visitors formed into groups and were conducted over the works; the guides being Mr. Bond, Mr. R. Walmsley (the Deputy-Engineer), and Mr. J. Blundell (the Distributing Superintendent). The following are some particulars of the

SOUTHPORT CORPORATION GAS UNDERTAKING.

In the year 1850, the Southport Corporation built gas-works in Eastbank Street, at a capital expenditure of £3528. During this year the make of gas was 578,000 cubic feet, and the gas sold to 69 consumers amounted to 295,000 cubic feet. There were 79 public lamps which consumed 230,700 cubic feet of gas. The price charged was 7s. 6d. per 1000 cubic feet; but this was reduced on Nov. 12, 1850, to 6s. 8d. Gas making continued at Eastbank Street until June 20, 1878, after which date the whole of the gas was manufactured at the Crowlands works. Gas manufacture commenced at these works on July 16, 1872; and from this date to 1878, both the Eastbank Street and Crowlands works supplied gas to the consumers of Southport and Birkdale. At the present time, the Southport Corporation Gas Estate has an area of about 12 acres.

The plant is capable of producing 3½ million cubic feet of gas per day. There is also plant for the manufacture of sulphate of ammonia, the distillation of coal tar, and the working-up of clinker, &c., into mortar. The Corporation have power to supply gas to all places within a radius of six miles from the Southport Town Hall. Gas is supplied to consumers within the borough at 2s. 8d. per 1000 cubic feet, with a discount of 5 per cent. if the account is paid within one month of the receipt of same. Special prices at the following rates are charged for gas for power purposes in Southport: Consumers of more than 250,000 cubic feet per quarter, 2s.; 125,000 to 250,000 feet, 2s. 2d.; 62,500 to 125,000 feet, 2s. 4d.; and less than 62,500 feet, 2s. 6d.—less 5 per cent. discount if the account is paid within a month of its receipt.

The make of gas for the year ended March 31 last amounted to 535,121,000 cubic feet; and the gas sold for cooking, lighting, heating, and power purposes (including street lighting) was 515,461,600 cubic feet. The make of residual products for the year was: Coke, 17,556 tons; breeze, 3759 tons; tar, 2631 tons; and sulphate of ammonia, 383 tons. The quantity of coal and oil carbonized was 45,028 tons.

The total capital expended to March 31 last amounted to £298,428; and the capital on mortgage was £197,725. This works out at 11s. 6d. and 7s. 8d. respectively per 1000 cubic feet of gas consumed.

Retort-House.

The retort-house which contained the direct-fired settings has been raised 13 feet to receive others on the regenerative principle. Four additional settings have been erected on the site of the old water-gas plant in an entirely new building adjoining the old retort-house. There are in all 144 through retorts working on the regenerative system. The retorts are 20 feet long, and made in two lengths, having a cross section of 22 in. by 16 in. At either side of the retort-bench is a stage flooring 11 ft. 6 in. above the ground level and 25 feet wide, the framework of which is made of steel joists supported on the retort-bench side by buckstays and columns, and on the outside by cast-iron columns. Running throughout the whole length are steel rails on which the stoking machinery travels.

Stoking Machinery.

This machinery, which comprises two drawing and two charging machines, was made by West's Gas Improvement Company. The machines work with compressed air at 60 lbs. pressure per square inch, and are capable of drawing and charging 90 retorts per hour. The air is compressed first in a low-pressure cylinder to about 25 lbs., and is then forced through a tubular cooler, to take out the heat developed by compression, to a high-pressure cylinder, after which it passes into a cylindrical receiver at a pressure of 70 lbs. per square inch, and is conveyed by means of wrought-iron pipes to the hollow shafts of four drums fitted overhead and in the middle of the retort-house. These drums carry a smaller drum, round which chains are fitted to counterpoise weights. The drums revolve automatically, and wind up or let out the hose piping as the machines travel from one retort to another.

Coal Elevators and Coke Machinery.

Coal is brought into the works by means of waggons, tipped into the breakers, and then elevated into hoppers fixed in the roof of the retort-house to supply the charging-machines. Fixed underneath the stage flooring, and close to the retort-benches, are shoots, which allow the coke drawn from the retorts to fall into coke-bogies, which travel on lines fixed on the ground floor, and convey the coke to the elevator by means of compressed air motors. After being slaked, the coke is conveyed to screening-plant, and then passes along into different bunkers of the overhead hopper, which holds 100 tons. By elevating the coke into this hopper, the loading of carts and waggons is greatly facilitated.

Purifying and Storage Plant.

There are four purifiers, each 24 feet long, 38 ft. 6 in. wide, and 5 ft. 6 in. deep; each box being filled with 60 tons of oxide of iron. There are in addition two oxide catch-boxes 34 feet long, 14 feet wide, and 4 feet deep. The storage capacity is 1,600,000 cubic feet. Two small holders have a capacity of 300,000 cubic feet each; and the larger one will contain 1,000,000 cubic feet. There are two station governors, one 36-inch, the other 20-inch.

Carburetted Water-Gas Plant.

There are three complete sets of carburetted water-gas apparatus, each capable of making between 500,000 and 600,000 cubic feet of gas per day. The two blowers in connection with this plant are driven by two 30 H.P. De Laval turbines, working at 1800 revolutions per minute.

Engine and Boiler Houses.

On the site of the old gas-enriching plant has been erected a new engine-house, 50 feet square, in which have been installed the air-compressor, two gas-exhausters used in connection with the carburetted water-gas plant, and a steam turbine blower. The coal-gas exhausters and engines have been placed in this house, with the result that considerable saving has been effected in the fuel used for steam-generating purposes. The boiler-house is 51 feet by 55 feet, and contains four boilers, two of which are 30 feet long and 8 feet diameter, and work at a pressure of 110 lbs. per square inch. Two smaller boilers, which are 28 feet long and 7 feet in diameter, work at a pressure of 100 lbs. per square inch. The boilers are of the Lancashire type, and fitted with Wilton's forced-draught furnaces; and they supply the whole of the steam required.

Sulphate of Ammonia Plant.

This plant is capable of producing 4 tons of sulphate of ammonia per day, and containing about 25 per cent. of ammonia.

Offices, Etc.

In connection with the works are a suite of offices, photometer-room, chemical and physical laboratory, and complete testing-plant. The Eastbank Street rooms are fitted for the repairing and cleaning of stoves, meters, lamps, &c. At the show-room, in Lord Street, there are exhibited appliances for cooking, lighting, &c.; the uses of which are demonstrated to the public on application. In a room adjoining the show-room, free lectures are given on cooking by gas by fully qualified lecturers.

Street Lighting.

The old method of lighting the streets by means of flat-flame burners has been superseded by the incandescent system; No. 3 Kern and "C" gas-burners having been adopted in most cases. There are also fixed a number of Welsbach and Lucas high-pressure lamps in some of the principal streets. The total number of lamps in use is 2428.

At the conclusion of the inspection, the party were taken to the spacious dining-room, which had been decorated for the occasion, where tea was served. Subsequently there was a little speech-making.

Mr. F. Thorp, in calling upon Mr. Allen to move a resolution, said he was sure all present had spent an instructive and enjoyable afternoon. They had been shown many things which were of particular interest to them, and had had an opportunity of seeing how Mr. Bond carried out his research work. Incidentally, he mentioned that Mr. Bond was one of the Lecturers at the Leeds University. Proceeding, Mr. Thorp said the dream of the gas engineer, that the gas-engine would displace the steam-engine, had been realized; and he hoped that those connected with the gas profession would exert themselves, and see that gas displaced electricity more than it had done. What the visitors had seen would stimulate them in this direction, and whet their appetite for further research.

Mr. E. Allen (Liverpool), in moving a vote of thanks to Mr. Bond, said there was no doubt as to the Southport Corporation having in him a valuable servant; and it was also a fact that the gas industry had in him a leading figure. It was more than ever necessary in these days that they should not only be good gas engineers but good chemists; and Mr. Bond had shown them that he had both qualifications. Referring to the work of the Manchester Junior Gas Association, Mr. Allen congratulated the President, officers, and members on the excellent results achieved. He alluded particularly to the course of lectures arranged to be

delivered at the Manchester University, and the classes established there for students in gas engineering.

Mr. R. H. GINMAN (Birkenhead), in seconding the motion, said he was sure that all present had greatly appreciated what they had seen. They were particularly indebted to Mr. Bond for the way he had explained the work carried on in the physical and scientific laboratories connected with the gas-works.

The resolution having been heartily carried,

Mr. BOND, in responding, said it had been a pleasure to him to take the members of the Association round the works; and he added that he would be glad to see them again at some future date. It was always difficult, in the short time available on such a visit, to show and explain everything in gas-works like those at Southport; but if the members of the party desired to see more, he would be willing at any time to give them another day. He had read with interest in the Technical Press of the work being done by the Association; and he hoped good results would accrue from the University scheme for the advancement of the gas industry. He was satisfied that the more they studied the scientific side of their work, the more would the industry prosper; and he was of opinion that the Research Committees on Refractory Materials and Carbonization, appointed by the Institution of Gas Engineers, had done good service.

This concluded the proceedings.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

Prizes for the Past Session's Work.

The Fourth Annual Social Gathering of this Association was held on Saturday, in the Corn Exchange Restaurant, Glasgow. Mr. J. FRAZER, of Provan (the President), occupied the chair. Tea was served, after which there was a concert, interspersed with a good deal of speaking.

The toast of "The Scottish Junior Gas Association" was proposed by Mr. T. WILSON, of Coatbridge, who said he regretted exceedingly that Mr. G. R. Hislop, of Paisley, who was to have been associated with him in proposing the toast, should not have been present, as he was undoubtedly the father of the profession in Scotland. The members of the Junior Association were to be complimented, firstly, on their numbers; secondly, on their earnestness in everything they appeared to turn their hands to; and, lastly, on the success which had attended their labours. The Junior Association was a fine training college for a gas manager or a gas engineer.

The PRESIDENT, in returning thanks, referred to the fact that their membership, which, at the institution of the Association, numbered a little over 100, was now 140. He reminded them that they had a big country district round about; and he thought that if their good friends of the North British Association of Gas Managers would try to do a little for them, in the way of advising the young men to join their Association, it would be for the benefit of the juniors, and also for the managers themselves. He held that, if the Junior Association was an advantage to the juniors, it was also a happy hunting ground for the managers. He begged to thank the donors of medals, and intimated that next year they were to receive a medal from Mr. J. Dunlop Smith, of Belfast. As the members already knew, the prizes for the best two papers read during last session had been awarded to Messrs. F. L. MacLaren, of Dumbarton, for his paper on "Producers and Internal Combustion Engines;" and Mr. J. M. Smith, of Dumfries, now of Stirling, for his paper on the "Manufacture of Sulphate of Ammonia." The first prize—a handsome gold medal—had been awarded to Mr. MacLaren. The medal was presented by one of their worthy honorary members—Mr. A. Smith, of Tradeston. Mr. MacLaren had been an able member and a willing worker since he joined the Association two years ago. His paper was one apart from anything which they, as workers in gas-works generally, had ever had anything to do with; but a careful study of it would show that the gas-engineer would ultimately be required at sea. The second prize was presented by Mr. Walter Grafton, of Glasgow, who also gave, along with his book entitled "A Handbook of Practical Gas Fitting," a sum of money to form the nucleus of a prize fund. He had much pleasure in presenting the medal to Mr. MacLaren. Mr. Smith was unable to be present.

Mr. MACLAREN briefly returned thanks for the medal.

Bailie PAXTON, the Convener of the Gas Committee of the Glasgow Town Council, proposed "Kindred Associations." He said he was not, until the other day, aware of the existence of such an Association. He was sure that the Gas Committee would be pleased to hear of their existence; and he thought they would give a very great deal of encouragement to all young men in their employment to further their knowledge regarding the manufacture of gas. Perhaps he might remind them that in the Gas Department of their city they employed between 3000 and 4000 men; and he was sure they would agree with him that some little encouragement should be given by the department to such strenuous efforts on the part of young men in their employment to improve themselves. He did his best to get the Lord Provost to come to this gathering, but his lordship could not. The Gas Committee were willing at all times to spend money for the purpose of developing the great undertaking in which they were engaged. Some time ago, as they were aware, they had a Smoke Abatement Exhibition, got up, in great measure, by their able and worthy Manager (Mr. Alex. Wilson); and it was common knowledge that it was a remarkable success—financial and otherwise. He would like to emphasize the great success it was, in having increased enormously the sale of gas appliances. He was told that from Ayr to Edinburgh every gas undertaking had recently increased their sales immensely, and had benefited greatly by the Glasgow exhibition. To the young men he would like to say that it was very good to increase their knowledge by book-learning. It was all very good to get up the science of gas producing, to know all the intricacies of gas-works and of gas-producing plant; but this knowledge, in many cases, without some energy on the part of the individuals themselves, became latent. They were in a very happy position in Glasgow, in having such an institution as the Technical College, where a great deal of information could be obtained at little cost. He was going to say that in another department of the Corporation, young men joined the service who were able to pass a certain examination in education. These men were all but compelled to attend the schools. They did not pay for the education, but the Corporation of Glasgow paid for it. He could not see why some inducement should not be offered by the Gas Department to young men; and he promised them, as Convener of the Committee, that if any such proposal were made he should give it all the influence in his power to see it put forward and brought to a finish. A short time ago their revenue was over a million sterling. How was this secured? By efficient management; by an efficient staff, a devoted staff—an army of men who were doing their very best, and who were spending their leisure hours in attending classes, to fit them for their work. He had to couple the toast with the name of their Manager, in whom every member of the Committee had the utmost confidence. It said a very great deal for Glasgow that, with so many private and public gas undertakings in Great Britain, their Manager should have been appointed President of the Institution of Gas Engineers.

Mr. ALEX. WILSON, in responding, congratulated the Association on the way it was improving, and the success which was attending all its business. He had a good deal to do with the inception of the Junior Association in the West of Scotland; and he had never regretted it. The Junior Association was not only a great benefit to the members, but also to the managers; and it was also a great benefit to companies and corporations to have young men equipping themselves for their work in the way they were doing. The Junior Associations were going to benefit the gas industry. There were strenuous times before them; but they had sufficient grit in them to take them and keep them to the front. He was glad to have his Convener there that night, so that he might learn something of what they were doing. He was going to take the Convener at his word, and it would not be his fault if they did not secure benefit in some way from the Convener's promises. The Institution of Gas Engineers were to meet in Glasgow next year; and they hoped to be able to show them something in their works, as to how they managed their business in Glasgow—a business which, he made bold to say, was as successful as that of any other gas-works in the kingdom. The undertaking had been well managed in the past by the Gas Committee; it was well managed at the present time; and it was not their fault if the gas undertaking of Glasgow was not in the forefront.

Mr. J. NAPIER MYERS (Saltcoats) proposed "The Chairman," who briefly responded.

Society of Chemical Industry.—At the meeting of the London Section of the Society on the 2nd prox., three papers will be submitted on subjects in which readers of the "JOURNAL" are interested. They are: "The Testing of Incandescent Mantles," by Messrs. J. H. Coste and W. E. F. Powney; and "Radiation Errors in Flow Calorimeters" and "A New Still Water-Gas Calorimeter" by the first-named gentleman in association with Mr. B. R. James.

Book-Keeping for Gas-Works.—We have received from Mr. Charles Sandell a copy of the second edition of his "Book-keeping for Gas-Works," which has lately been published by Messrs. Eden Fisher and Co., Limited. In his preface, the author says that though he has no intention of claiming the great merit of novelty for his system, he ventures to offer it again in the light of a useful model, guide, and assistant, requiring no apology for its appearance; and he trusts that the book, which contains new matter evolved in the lapse of time, will be found useful to all who may be induced to consult its pages.

Industrial Pyrometry.—The concluding lecture of the series announced to be delivered at the Royal Society of Arts on this subject by Mr. C. R. Darling, F.I.C., was given on Monday evening last week, when attention was directed to the Féry radiation pyrometer, the Holborn-Kurlbaum and other optical pyrometers, and the Wanner pyrometer. The lecture closed with some observations on the special uses of radiation pyrometers in pottery manufacture and works at high temperatures. On the motion of Sir Henry Trueman Wood, the Secretary of the Society, who presided, a vote of thanks was accorded to Mr. Darling, who is one of the teaching staff of the Finsbury Technical College. The lectures are to be published in the Society's "Journal" during the Christmas recess.

EXTRACTING CYANOGEN FROM COAL GAS.

By M. E. MUELLER, of New York.

[A Paper read before the American Gas Institute.]

Before describing in detail the method used for the extraction of cyanogen at the Astoria works, the writer will mention the theory of the formation of cyanogen in the process of carbonization, the reasons for removing it from the gas, and the principles involved in the different methods of extraction.

Gas coals contain from 1 to 2 per cent. of nitrogen. In the process of carbonization, roughly one-half of this nitrogen remains with the coke; about one-third appears as free nitrogen in the gas; and approximately one-sixth is converted into ammonia. Besides these three principal outlets for the nitrogen, small amounts are found in the tar and in the form of hydrocyanic or prussic acid (HCN) which passes off with the gas.

Foster ["JOURNAL," Vol. XL., p. 1124] found with coal containing 1·73 per cent. of nitrogen that this became distributed as follows:—

In coke	49·90 per cent.
In gas	31·04 ,,
As ammonia	14·50 ,,
As cyanogen	1·56 ,,

M'Leod ["JOURNAL," Vol. XCVII., p. 748] reports the percentage of total nitrogen retained by the coke as varying from 30·2 to 89·6 per cent., with an average of 58·3 per cent. on eighty coals tested; nitrogen as ammonia, 17·1 per cent.; in tar, 3·9 per cent.; in cyanogen, 1·7 per cent.; and in the gas, 19·5 per cent.

Knublauch ["JOURNAL," Vol. LXVI., p. 1242] found that in the gas-works at Cologne 1·8 per cent. of the total nitrogen is converted into cyanogen.

The coal used at Astoria averages 1·35 per cent. of nitrogen, which is equivalent to 30 lbs. per ton. Of this, slightly over 5 lbs. (equivalent to 24 lbs. of sulphate) is converted into ammonia. The amount of cyanogen in the gas averages 110 grains per 100 cubic feet, or 1·73 lbs. per ton of coal carbonized. This is equivalent to 0·93 lb. of nitrogen, or 3·1 per cent. of the total nitrogen of the coal.

The commonly accepted theory regarding the formation of hydrocyanic acid is that it is a decomposition product of ammonia with the hot coke in the retort. This transformation takes place as follows:

$$\underset{\text{Carbon.}}{C} + \underset{\text{Ammonia.}}{NH_3} = \underset{\text{Hydrocyanic acid.}}{HCN} + \underset{\text{Hydrogen.}}{H_2}.$$

By passing ammonia over heated charcoal in a porcelain tube, Bueb ["JOURNAL," Vol. LXVII., p. 1033] found that hydrocyanic acid was formed, and that at temperatures ranging from 1472° to 2156° Fahr. the amount of cyanogen produced increased with the temperature. At the same time the decomposition of the ammonia into nitrogen and hydrogen increased with the temperature.

Bergmann, continuing the above investigation, found that diluting the ammonia with coal gas, and passing the mixture over heated charcoal, increases the cyanogen formed, and decreases the amount of ammonia broken up into nitrogen and hydrogen; and the most favourable temperature for the formation of cyanogen is in the neighbourhood of 1100° C. (2012° Fahr.). He also found that only negligible amounts of cyanogen are produced from the interaction of ammonia and carbonic oxide.

$$NH_3 + CO = HCN + H_2O.$$

The fact that cyanogen is a high-temperature decomposition product of ammonia, indicates that a high yield of cyanogen would be accompanied by a low yield of ammonia. This, however, is not necessarily true; nor do the results obtained at Astoria bear out this conclusion. The facts of the case probably are that a great deal of the ammonia formed during carbonization is decomposed before the gas leaves the retort—most of it into free hydrogen and nitrogen. If such conditions could be approached in the retort that only a small part of the ammonia formed would be decomposed, and all of this converted into cyanogen, high yields of both of these products would result. As a matter of fact, in the plants at Astoria, simultaneous high or low yields of both of these products have more frequently been the case than a high yield of one at the expense of the other.

There are two reasons for removing cyanogen from gas. In the first place, it is an objectionable impurity, and, secondly, if recovered in a suitable form it becomes a valuable bye-product. Cyanogen, if allowed to remain in the gas, becomes objectionable first in the purifiers. Here it combines with the oxide of iron to form ferrocyanide compounds; and the iron so combined becomes unavailable for the extraction of hydrogen sulphide. The purification records at Astoria show a great improvement in the amount of gas purified, per bushel per charge, after the extraction of cyanogen was begun. But, on account of the varying conditions in the purifying houses, some of this improvement may be due to other causes. The absorption of cyanogen by the oxide, although it has a detrimental effect on hydrogen sulphide purification, is beneficial in another direction. Spent oxide containing much ferrocyanide becomes valuable as a raw material for the manufacture of cyanogen compounds, and has a better sale than other spent oxide.

The purifiers, however, generally allow a considerable portion of the cyanogen to pass forward with the gas. When this happens, the cyanogen exerts a corrosive action on iron and steel with which the gas comes in contact. The blue colour, often noticeable on the outside of gasholder sheets—especially around leaky rivets—is due to cyanogen corrosion. The same corrosion takes place in service and house pipes, frequently resulting in a stoppage of the pipe.

The profit to be derived from the extraction of cyanogen depends on the market for ferrocyanides, as it is to these compounds into which the cyanogen is converted. The "Census Report" of 1905 gives the production of potassium ferrocyanide as 5,027,264 lbs., valued at $683,277, or about 13½ c. per pound. The importation from Europe of sodium and potassium ferrocyanide combined, for the two years 1908 and 1909, averages about 3,100,000 lbs.; bringing the total consumption in this country to about 8,000,000 lbs. Another authority estimates the consumption at 6,000,000 lbs. annually, with the production in this country somewhat over half this amount. Assuming a demand of 8,000,000 lbs. of potassium ferrocyanide, equivalent to about 3,000,000 lbs. of cyanogen, this, on a yield of 1¼ lbs. per ton of coal, could be supplied from the carbonization of 2,400,000 tons. If the recovery of cyanogen in gas-works and coke-ovens became general, the supply would be far in excess of the demand. Besides, there are other sources of ferrocyanides which must be taken into consideration. The old pot process, by which ferrocyanides were made by heating refuse animal matter (principally scrap leather) in iron pots with potash, is becoming obsolete; but large quantities of ferrocyanides are now being obtained from the residue of the beet sugar factories in Europe, which process is about to be introduced in this country. One of the principal uses of potassium ferrocyanide formerly was for the manufacture of potassium cyanide, which is used extensively in gold mining; but the manufacture of potassium cyanide from the ferrocyanide has been superseded almost entirely by synthetic processes. The prospect of the extraction of cyanogen becoming a very profitable operation for gas-works is not very good unless new uses for ferrocyanides are found. The principal use at present is for the manufacture of prussian blue, in dyeing and textile printing.

In order to understand the extraction of cyanogen from coal gas, it is necessary to know something of the chemistry of cyanogen compounds. Hydrocyanic or prussic acid (HCN), which is the form in which the cyanogen probably exists in the gas, is a very weak acid; its acidic properties being even less than those of carbon dioxide or hydrogen sulphide. This means that its power for combining with bases is less than that of the other two acids. A current of carbon dioxide passed through a solution of potassium cyanide will liberate hydrocyanic acid and form potassium carbonate. It is because hydrocyanic acid is such a weak acid that very little of it is absorbed in the ammonia washers as ammonium cyanide. Any ammonium cyanide formed would be decomposed by the carbonic acid and sulphuretted hydrogen in the gas, and hydrocyanic acid again set free.

Hydrocyanic acid in combining with iron, however, forms hydroferrocyanide acid, which is a stronger acid than either carbonic acid or sulphuretted hydrogen. If a solution of potassium cyanide is added to a solution of ferrous salt, there is first found a precipitate of ferrous cyanide—

$$\underset{\substack{\text{Potassium}\\\text{cyanide.}}}{2KCN} + \underset{\substack{\text{Ferrous}\\\text{sulphate.}}}{FeSO_4} = \underset{\substack{\text{Ferrous}\\\text{cyanide.}}}{\underline{Fe(CN)_2}} + \underset{\substack{\text{Potassium}\\\text{sulphate.}}}{K_2SO_4}*$$

On adding an excess of potassium cyanide, the ferrous cyanide is dissolved, with the formation of potassium ferrocyanide—

$$\underset{\substack{\text{Ferrous}\\\text{cyanide.}}}{\underline{Fe(CN)_2}} + \underset{\substack{\text{Potassium}\\\text{cyanide.}}}{4KCN} = \underset{\substack{\text{Potassium}\\\text{ferrocyanide.}}}{K_4Fe(CN)_6}$$

Potassium ferrocyanide is not a salt of hydrocyanic acid, but of hydroferrocyanic acid, which acid is formed as a white crystalline precipitate when hydrochloric acid is added to a solution of potassium ferrocyanide. Nor does potassium ferrocyanide possess the characteristics of hydrocyanic acid and its salts, the most pronounced of which is their extremely poisonous nature. Hydroferrocyanic acid being a stronger acid than carbonic acid or sulphuretted hydrogen, its salts are not decomposed by these two gases; and if conditions are such that salts of hydroferrocyanic acid can be formed, the hydrocyanic acid can be extracted from the gas, even in the presence of carbonic acid or sulphuretted hydrogen. This requires the presence of a ferrous salt with excess of alkali.

Another acid of cyanogen, that is stronger than either sulphuretted hydrogen or carbonic acid, is sulphocyanic acid (HCNS). In the presence of an alkali and free sulphur, hydrocyanic acid is converted into sulphocyanic acid, which, combining with the alkali, forms a sulphocyanic salt. It is on this principle that the process of the British Cyanides Company for the extraction of cyanogen from gas depends—

$$(NH_4)_2S + \underline{2S} + \overline{2HCN} = 2NH_4CNS + \overline{\underline{H_2S}}.$$

* To distinguish between the insoluble and gaseous bodies in chemical formulæ, the following system is often used:—

A line over the formula indicates a gas—*e.g.*, $\overline{CO_2}$, $\overline{H_2S}$.

A line under the formula indicates an insoluble substance—*e.g.*, $\underline{Fe(CN)_2}$, $\underline{FeS}$.

A formula written without a line indicates a liquid or soluble substance—*e.g.*, KCN, $Fe(CN)_6$.

In the ordinary process of gas purification, a considerable portion of the hydrocyanic acid is absorbed in the purifiers. In the spent oxide cyanogen is found both as ferrocyanide and sulphocyanide. The amount of the latter compound, which is of little value, increases with the amount of ammonia in the gas; so that, in order to obtain spent oxide as rich as possible in the more valuable ferrocyanides, the ammonia should be removed completely. [See "JOURNAL," Vol. LXVI., p. 1294.] To extract the ferrocyanide from the spent material, the oxide is lixiviated with water to remove the soluble salts. The oxide is then treated with lime to convert the ferrocyanide present into calcium ferrocyanide, which is soluble and is separated from the oxide by filtration. From the solution, the ferrocyanide is precipitated by ammonium salts in the form of an insoluble double ferrocyanide of calcium and ammonium, which is converted into potassium ferrocyanide by treating with potassium carbonate.

The methods for the extraction of hydrocyanic acid from the gas in the wet may be divided into two general classes, according to whether the cyanogen is converted into a ferrocyanide or sulphocyanide. The latter process is that of the British Cyanides Company, and has made considerable headway in England. It consists in washing the gas with ammoniacal liquor to which sulphur has been added. The ammonium sulphide present in the liquor dissolves the sulphur to form a polysulphide $(NH_4)_2S_2$, which, reacting with the hydrocyanic acid of the gas, forms ammonium sulphocyanide (NH_4CNS).

$$(NH_4)_2S_2 + \overline{2HCN} = 2NH_4CNS + \overline{H_2S}.$$

The ammonium sulphocyanide is converted into either potassium cyanide or potassium ferrocyanide.

A great many different methods have been patented for the extraction of hydrocyanic acid from the gas in the form of ferrocyanide. All of them have this in common—namely, that the gas is scrubbed with an alkaline solution containing an oxide, hydrate, or salt of iron. These methods may be grouped under two classes, according to whether a fixed alkali, such as potash, sodium, carbonate, or lime, is used, or whether the gas itself supplies the alkali in the form of ammonia. Of the former class, only brief mention will be made. In this, according to the method of Foulis, the gas after being freed from ammonia is scrubbed with a solution of potassium of sodium carbonate containing oxide or carbonate of iron in suspension. The chemical reaction taking place is as follows:

$$2K_2CO_3 + \underline{FeCO_3} + \overline{6}HCN = K_3Fe(CN)_6 + \overline{3CO_2} + 3H_2O$$

Potassium carbonate.	Ferrous carbonate.	Hydrocyanic acid.	Potassium ferrocyanide.	Carbon dioxide.	Water.

The cyanogen is directly obtained as a solution of potassium ferrocyanide, from which the salt is obtained by evaporation.

One of the first processes using the ammonia of the gas as an alkali for the extraction of hydrocyanic acid is that of Rowland. According to his method, an iron salt is added to the water used in the ammonia scrubbers. The cyanogen is absorbed as ammonium ferrocyanide, which remains in solution. Before distilling the ammoniacal liquor thus obtained, more iron salt is added, which, upon distillation of the liquor, combines to form an insoluble double ferrocyanide of iron and ammonia similar to the product obtained in the Bueb process.

The Bueb process, which is the one in use at Astoria, differs from Rowland's in that only a portion of the ammonia in the gas is absorbed with the cyanogen, the remainder being absorbed in the usual manner, and in that most of the cyanogen is obtained directly in an insoluble form. Briefly, the process consists in scrubbing the gas before the removal of the ammonia with a solution of ferrous sulphate (copperas). The reactions which take place are as follows:

First, the ammonia and hydrogen sulphide of the gas convert the copperas into ferrous sulphide (FeS)—

$$FeSO_4 + \overline{2NH_3} + \overline{H_2S} = \underline{FeS} + (NH_4)_2SO_4.$$

Ferrous sulphate.	Ammonia.	Hydrogen sulphide.	Ferrous sulphide.	Ammonium sulphate.

The ammonium sulphate formed remains in solution while the ferrous sulphide is in suspension. After the above reaction has taken place the hydrocyanic acid is absorbed, together with more ammonia by the ferrous sulphide, with the formation of an insoluble double ferrocyanide of ammonia and iron [$(NH_4)_2FeFe(CN)_6$] ; hydrogen sulphide being liberated.

$$\underline{2FeS} + \overline{2NH_3} + \overline{6HCN} = \underline{(NH_4)_2FeFe(CN)_6} + \overline{2H_2S}.$$

Most of the cyanogen is converted into this insoluble double ferrocyanide, which is light yellow in colour. The double ferrocyanide is, however, partly decomposed by the ammonia and sulphuretted hydrogen in the gas into ammonium ferrocyanide (which is soluble) and ferrous sulphide. The black colour of the ferrous sulphide hides the yellow of the double ferrocyanide, so that the mud in the washer, instead of becoming yellow, is almost black. This decomposing of the double ferrocyanide may be expressed by the following equation:

$$\underline{(NH_4)_2FeFe(CN)_6} + \overline{2NH_3} + \overline{H_2S} = (NH_4)_4Fe(CN)_6 + \underline{FeS}.$$

Ammonium ferrocyanide.	Ferrous sulphide.

The ferrous sulphide thus formed can extract more hydrocyanic acid. The longer the material is left in the washer, the more soluble ammonium ferrocyanide is formed; but as it is the insoluble compound which is the final product desired, the material is left in the washer only long enough until it has absorbed sufficient cyanogen to combine with all the iron present in the form of the insoluble compound.

The mud as it is drawn from the washer consists, therefore, of insoluble ammonium, ferrocyanide, and insoluble ferrous sulphide; while in solution are ammonium sulphate, from the decomposition of the copperas and ammonium ferrocyanide, together with the compounds occurring in crude ammoniacal liquor. To convert the soluble ferrocyanide into the insoluble form, the mud is either boiled or made slightly acid with sulphuric acid. On boiling, the ammonium ferrocyanide reacts with the ferrous sulphide, as follows:

$$(NH_4)_4Fe(CN)_6 + \underline{FeS} = \underline{(NH_4)_2FeFe(CN)_6} + \overline{2NH_3} + \overline{H_2S},$$

while the action of the sulphuric acid accomplishes the same result, except that more ammonium sulphate is formed:

$$(NH_2)_4Fe(CN)_6 + FeS + H_2SO_4 = \underline{(NH_4)_2FeFe(CN)_6} + (NH_4)_2SO_4 + \overline{H_2S}.$$

In both cases the insoluble double ferrocyanide is formed and the mud changes colour from almost black to light yellow. The final products are, therefore, an insoluble, double ferrocyanide, and a solution of ammonium sulphate, which are separated from each other by filtration.

Only two raw materials are used for the process—viz., ferrous sulphate (copperas) and sulphuric acid. On a yield of 1·75 lbs. of cyanogen per ton of coal, there would be required theoretically 6·3 lbs. of copperas. The actual amount used for three months was 5·66 lbs., which is 90 per cent. of the theoretical. As the efficiency of the washers is about 85 per cent., the amount of copperas used is practically what would be theoretically expected. The quantity of sulphuric acid (oil of vitriol) used for neutralizing the mud is somewhat less than 1 lb. per ton of coal carbonized. The ammonia absorbed in the process is equivalent to from 4·8 lbs. of ammonium sulphate per ton of coal. About two-thirds of this appears as ammonium sulphate and one-third as insoluble ammonia in the press cake.

The cyanogen scrubbers at Astoria are placed after the naphthalene washer but before the condensers. They are 12 feet in diameter, and divided into five compartments. Four of these are filled with rotating wooden bundles, and are used for the extraction of cyanogen; while the fifth, at the gas outlet end of the washer, contains twelve perforated iron plates spaced about 3 inches apart. These plates also rotate with the shaft of the washer. The function of this compartment is to convert the ferrous sulphate into ferrous sulphide and ammonium sulphate. Experience has shown that this bay, which we call the agitator, is hardly ample for the work. With only twelve plates, and these not arranged so that the gas must pass between them, the copperas solution is not exposed to the gas sufficiently to convert it entirely into ferrous sulphide, in case it is necessary to empty more than two bays from the washer on the same day, and if the copperas solution is pumped forward into the bays filled with wooden bundles before this conversion is complete, it is almost sure to cause a stoppage.

At the side of the washer are two pumps driven from the engine which turns the bundles. The suction and discharge pipes of these pumps are arranged so that all the necessary operations of pumping the copperas solution into the washer, advancing it from one compartment to another, and discharging the mud after it has become saturated, can be done with them.

When the cyanogen washers were first put in use, it was found that the cyanogen absorption was far from being complete. In order to provide greater capacity, the connections on the last four bays of the naphthalene washers, which are placed immediately before the cyanogen washers, were changed, so that they could be used for the extraction of the cyanogen. This practically doubled the absorbing surface available for cyanogen extraction, and improved the efficiency. But even now, with the increased area for absorption, the washers will at times absorb as low as 50 per cent. of the cyanogen. Then, again, for no apparent reason, the efficiency will increase to 95 per cent. On the average, about 85 per cent. of the cyanogen is extracted. The extraction appears to be more complete in the cold weather than in summer, notwithstanding the fact that more gas is passing the washers. This is probably due, to some extent, to the greater condensation of water taking place during the warm weather, and consequent dilution of the absorbing material.

In explaining the operation of the Bueb system, as carried out at Astoria, it will be assumed that the washers are empty and about to be put into use. The copperas solution is made in concrete, waterproofed tanks provided with motor-driven paddles. Fresh water or wash water from the filter presses is put into these tanks and the requisite amount of copperas is run in from graduated hoppers. For every 700 gallons of water, which is the amount required to fill the agitator of the washers, 2400 lbs. of copperas is generally used. During the warm weather a little more copperas is used, to allow for the condensation from the gas, in order that the mud should not become too thin. The solution of copperas is pumped into the agitator bay of the cyanogen washers; the other bays being left empty until the ferrous sulphate has been converted to ferrous sulphide in the agitator by the action of the gas. This

is ascertained by drawing off a little of the liquor from the agitator, filtering, and adding a solution of ammonium sulphide (crude gas liquor) to the filtrate. If the filtrate remains clear, the conversion of sulphate to sulphide has been completed. The mud in the agitator is now pumped into the two preceding bays. The proportions of the washer are such that the capacity of the agitator is equal to two of the bays used for cyanogen absorption. The agitator is filled with a fresh solution of copperas. When this has been converted into ferrous sulphide, the mud in the preceding bays is pumped into the two bays ahead, and the agitator is again emptied into the two preceding bays and filled with fresh copperas solution. This operation is repeated until all the bays of the washer are filled. When the mud in the first two bays has become saturated, it is pumped to the storage tank; and the mud in all the other bays is moved forward, and the agitator again filled with copperas solution. To test whether the mud in the washer has absorbed sufficient cyanogen, a sample is taken and acidified with sulphuric acid. After stirring well, a drop of the mud is put on a piece of white filter-paper. Near it is put a drop of dilute ferric chloride solution, so that the liquid from the two drops as they spread out on the paper will come together. A blue colour occurring at the point where the drops meet is a sign that the mud contains an excess of ferrocyanide over iron, and is therefore ready to be drawn off. This test is very simple, and is made by the man who attends to the other operations of pumping, filling, &c.

In order to simplify the operation, some of the washers have been altered so that the flow of the absorbent liquid through the washer is continuous. The copperas solution is run into the agitator in a small stream, and the saturated mud overflows from the first bay. When the test of the mud in the first bay shows that it has not absorbed sufficient cyanogen, the copperas solution is stopped, and not run in until the material in the first bay is saturated. This makes the operation of the washer much easier, as the only pumping required is the filling of the overhead tank with copperas solution.

The mud from the mud storage tank is pumped into covered, lead-lined neutralizing tanks, provided with paddles, which keep the material agitated, where it is neutralized with sulphuric acid and heated to about 200° Fahr. The acid (oil of vitriol) is stored in a steel tank, from which it is forced by compressed air into small, lead-lined tanks resting on top of the neutralizing tanks. In these tanks, the acid is diluted with about three times its volume of water. The addition of acid changes the colour of the mud to light yellow. During this operation, large quantities of hydrogen sulphide are set free. In order that this does not escape into the room, the tanks are fitted with vent-pipes (connected to a fan) which discharge the gases out of the building. Enough acid is used so that the material is slightly acid to litmus. The mud is again tested for soluble ferrocyanide with ferric chloride solution on a piece of white filter-paper; and if the blue colour results, as it generally does, copperas solution is added (a few pailfuls at a time) until the blue colour no longer appears on testing. The action of the copperas is to precipitate the soluble ferrocyanide—

$$\underset{\text{Ammonium ferrocyanide.}}{(NH_4)_4Fe(CN)_6} + \underset{\text{Copperas.}}{FeSO_4} = \underset{\text{Ammonium-ferro ferrocyanide.}}{(NH_4)_2FeFe(CN)_6} + \underset{\text{Ammonium sulphate.}}{(NH_4)_2So_4}.$$

The mud now consists of insoluble, double ferrocyanide of ammonia and iron and a solution of ammonium sulphate with a little ferrous sulphate and very little free acid. This mud is pumped into filter presses. The pumps used for this are lined with acid bronze. After the press is full, hot water is pumped through, in order to wash out as much as possible of the ammonium sulphate. The wash-water, which is a very dilute solution of ammonium sulphate, is used for making-up the copperas solution. Even with a washing-press it is very difficult to wash out the ammonium sulphate. The best results are obtained by finishing the pressing with mud made by stirring up some of the finished press-cake with water until it disintegrates. The presses are about two-thirds filled with the neutralized mud from the washers, and then finished with the mud made from the finished cake. In this way, the gravity of the liquid coming from the presses is brought down from 8 to 10° Baumé to 1 to 2° before washing with water.

The solution of ammonium sulphate which runs from the filter presses is neutralized with ammonia. For this purpose, some of the mud as it comes from the washers is boiled, and the gases (principally ammonia and hydrogen sulphide) pass into the ammonium sulphate liquor from the presses. This not only neutralizes the free acid, but also precipitates the small amount of iron present. This is necessary to avoid discoloration of the sulphate. The neutralized liquor is allowed to settle and the clear solution evaporated in lead-lined pans. This solution contains approximately 1 lb. of ammonium sulphate per gallon. This sulphate separates out on evaporation, and is dried in a rotary drier by means of a current of air from a small blower heated by passing over steam radiators before going through the drier. About 2·5 to 3 lbs. of sulphate are produced per ton of coal carbonized.

The cyanogen cake from the filter presses is sufficiently firm to be handled with a shovel and bagged. It contains on an average by weight 50 per cent. of water, 20 to 24 per cent. of cyanogen, and 5 to 6 per cent. of ammonia. About 6 lbs. of press-cake are produced per ton of coal carbonized. When the cake first comes from the presses, it is yellow in colour; but on contact with air it rapidly turns deep blue, due to oxidation.

The cake as it comes from the presses is bagged and sold to chemical works, where it is converted into potassium or sodium ferrocyanide. This is done by boiling with a solution of caustic potash or soda, whereupon the ammonia distils off and ferrocyanide of potash or soda is formed. This is filtered from the residue of iron hydrate, evaporated, and purified by recrystallization.

Appendix.

Estimation of Cyanogen in Coal Gas.—To determine the amount of cyanogen in gas, the cyanogen is converted into potassium ferrocyanide by passing the gas through a caustic potash solution, containing freshly precipitated ferrous hydrate in suspension. After filtering the potassium, ferrocyanide is determined in the clear solution by acidifying and titrating with a standard solution of zinc sulphate until all ferrocyanide has been precipitated as zinc ferrocyanide.

The end reaction is determined as follows: A drop of a 1 per cent. solution of ferric chloride is put on a piece of white filter paper absolutely free from iron. A drop of the liquid being tested is then put on the paper, near the drop of ferric chloride, so that the liquor as it spreads out on the paper will come in contact with the ferric chloride. Care must be taken that the precipitate of zinc ferrocyanide does not come in contact with the iron solution. As long as there is any ferrocyanide left in solution, a blue colour will appear where the two drops come in contact, due to the formation of prussian blue. When all ferrocyanide has been precipitated the colour will no longer appear, which indicates the end point of the titration.

The zinc sulphate solution is made by dissolving approximately 5 grammes of c.p. zinc sulphate ($ZnSO_47H_2O$) in 1 litre of water with the addition of 10 cc. of sulphuric acid. This solution is standardized with a potassium ferrocyanide solution (10 grammes c.p.—$K_4Fe(CN)_53H_2O$ per litre). Then 25 cc. of the potassium ferrocyanide solution are put into a beaker and titrated with the zinc sulphate solution; the end reaction being determined as above. One cc. of the ferrocyanide solution is equivalent to 0·0570 grain of cyanogen, from which the value of the zinc solution is calculated.

To test for cyanogen in gas, put 15 cc. of a 10 per cent. ferrous sulphate ($FeSO_47H_2O$) solution into each of three wash-bottles. Add 15 cc. of 20 per cent. caustic potash solution to each bottle, and pass about 3 cubic feet of gas through these bottles at the rate of about 1 cubic foot per hour. Rinse the contents of the bottles into a beaker; add 20 cc. more of the caustic potash solution; and heat to boiling. Filter and wash with hot water until a few drops of the filtrate no longer show a blue colour when acidified and tested with a drop of 1 per cent. ferric chloride solution. Transfer the filtrate to a 500 cc. graduated flask, dilute to the mark, and shake well. Take 100 cc. of this solution and transfer to a beaker by means of a pipette. Slowly add dilute sulphuric acid (1·5), stirring constantly until the solution shows slightly acid towards litmus. Then run in the zinc sulphate solution, a few drops at a time, until the drop-test, as explained above, shows that the ferrocyanide has all been precipitated. From the amount of zinc sulphate solution used, the quantity of cyanogen in the gas is calculated.

The method used to determine the percentage of cyanogen in the press-cake is similar. A sample of cake (about 10 grammes) is boiled with caustic potash solution, during which operation the ammonia distils off, and may be estimated by absorbing in standard acid. In this way, the ferrocyanides are converted into potassium ferrocyanide. The solution is made up to 1 litre in a graduated flask, allowing 5 cc. for the solid matter, filtered, and the cyanogen determined in an aliquot part of the filtrate.

GAS AT THE SCOTTISH NATIONAL EXHIBITION

In Glasgow next May.

High-pressure gas lighting at the Exhibition of Scottish History Arts, and Industry, to be opened in May next in Glasgow, will, it is understood, bear a very important part in the general lighting and illumination scheme of the grounds. The general lighting covers the introduction of 130 single-mantle inverted lamps of 1500-candle power. The lamps will be fitted on standards, the design of which will be in keeping with the decorative scheme of the building. The standards are of two designs—one being for a single lamp and fitted with a suitable swan-neck, the other to carry three lamps and fitted with a well-designed bracket. The compressing plant—in a building by itself and situated directly opposite the Industrial Hall—will consist of two compressors coupled direct to two gas-engines. Each set will be capable of dealing with the lighting load by itself. A feature of the plant is the pressure regulating and bye-pass valve which is built directly on the body of the compressor—thus making it very accessible, and the plant exceedingly compact. The entire equipment will in some respects be novel; and it should prove both interesting and instructive. Messrs. James Milne and Son, Limited, of Edinburgh, have been entrusted with the contract for the installation; and the scheme (prepared to the plans and specification of Mr. A. Crighton Freeman, the Chief Engineer to the Exhibition Authorities) is already taking shape on the grounds, and will be finished well up to time for the opening day.

FIRE-BRICKS.

By E. M. STEWART, of the Bonnyside Fire-Brick Works.

[Abstract of Paper read before the Scottish Junior Gas Association, Eastern District, on Dec. 10.]

In my paper to-day, I propose to give some general details, and also to deal with points regarding which definite conclusions have been reached; and in doing so, I shall use the simplest and least technical language possible, so that even those unacquainted with chemical formulæ may understand the points raised.

In some districts—particularly in Wales—fire-clay and silica clay are worked open-cast; but fire-clay is seldom found in sufficiently pure form near the surface in this district to be worked in such a manner, and therefore pits have to be sunk, the depths of which vary considerably. In our Bonnyside and Russell pits, the clay is found at a depth of about 70 feet from the surface. Including coal, fire-clay or aluminous clay, and ganister or silicious clay, the total height of our working face is about 20 feet. A small rib of ironstone or brownstone found immediately below the coal, is the distinguishing feature of the particular deposit of refractory materials which exist in this district. Every precaution has to be exercised underground, so as to prevent the different seams of fire-clay and ganister clay being mixed, and particularly to prevent the admixture of coal with either. During the mining operations, the fire-clay, being soft, is broken up into small pieces, and, as a rule, without further treatment can be filled direct into the grinding-pans in the state in which it arrives at the pit-head. But the ganister clay, being extremely hard, has first of all to be put through stone breakers and crushed into small pieces.

Owing to the diversity of purposes for which the material is required, and the varying conditions it has to withstand, the greatest care has to be taken with the mixture and the selection of the clays. In some parts of furnaces, bricks made of highly aluminous clay have been found most satisfactory; while in others, the very opposite has been found to be the case. Users, therefore, when ordering bricks, should particularly specify for what class of furnace, and for what portion of the furnace, the various sizes are required. With this information before them, fire-brick manufacturers would be in a much better position to supply suitable material. As an illustration, ganister brick has been found, when used in the crowns of puddling-furnaces, and for certain parts of gas-works furnaces, to last very much longer than any quality of fire-clay brick; but this brick would be entirely unsuitable for portions of furnaces in contact with the metal.

The grinding, sifting, picking, and pugging of the clay, before it is ready for milling, should always be one of the most carefully supervised departments. The question of totally displacing hand labour during these operations has been for long a debatable point. Where entirely mechanical methods are adopted, the result is that all the impurities which the seam of clay may contain are ground up with the clay; whereas these are detected and rejected when this part of the manufacture is carried through by hand labour. I have for a long time considered the possibility of introducing machinery which would automatically reject such impurities, but so far have not discovered any method which is so entirely satisfactory as intelligent hand labour. After the material is ground, sifted, and pugged, or milled, into a plastic condition with water, it is carried to the moulder's bench, and subsequently the moulded bricks are deposited on the drying floor, where they remain for a few days, during which period the greater part of the added water, used during the milling process, is expelled. When sufficiently dry, the bricks are taken from the drying floor, and conveyed to the kilns to be burned. This latter process occupies from eight to twelve days, dependent upon the size, quality, and shape of the material which the kiln contains. If, in addition to the ordinary size of brick, the kiln contains large and difficult shaped blocks, the greatest care has to be taken, both in the initial drying stage and also in the subsequent cooling of the kiln. One of the most fruitful sources of failure in gas-works construction is improperly burned material. This very often is not entirely the fault of the brick manufacturer, but of the gas engineer, who, delaying till the last moment ordering his material, wishes delivery so promptly that it is impossible to thoroughly dry and burn the material and meet his views as to delivery. The question of reducing the cost of milling and drying has been one which has received the careful attention of fire-brick manufacturers for a considerable time; and some firms have endeavoured to cheapen the process by manufacturing their bricks by machine, instead of making them by hand. The suitability of the manufactured material, however, has been, and will continue to be, the deciding factor; and at the present time the hand-made article retains its old popularity. The table shows the extent of this industry in the United Kingdom for a considerable number of years.

Year.		Clay Milled. Tons.	Value.
1873	Scotland	232,952	Cannot be stated.
	United Kingdom	1,452,864	do.
1880	Scotland	365,139	do.
	United Kingdom	1,938,539	do.
1890	Scotland	607,865	£116,153
	United Kingdom	2,543,192	546,500
1900	Scotland	783,306	143,364
	United Kingdom	3,136,624	615,951
1905	Scotland	1,650,129	231,291
	United Kingdom	3,261,251	714,886
1909	Scotland	985,171	212,888
	United Kingdom	3,104,627	668,821

Comparisons between the methods adopted in this country and in Germany have recently been frequent; but so far as my own personal knowledge goes, the volume of fire-brick material imported into this country from German sources has been extremely small—in fact, so small that it might be said that it has only been for trial purposes, and that from the strictly commercial point of view imports have been *nil*. There has, however, been one striking exception. I refer to the importing of bricks for lining patent bye-product coke-ovens, of which, owing to the failure of British material in past years, large quantities have been imported. I am pleased to state, however, that, as a result of careful tests and exhaustive experiments, we were able some years ago to manufacture a brick in all respects equal, if not superior, to the best foreign material imported into this country for such purposes.

Before passing from this comparison of British and foreign materials, I may state that I have made exhaustive inquiries, both at home (in large, medium-sized, and small works) and also in Germany itself, as to the relative merits of the two classes of retorts; and I am pleased to state that the consensus of opinion has been strongly in favour of British material. Though personally with a limited experience of retorts, it seems to me that the longer life of the German retort is partly accounted for by the greater stability and protection of the surrounding and supporting brickwork.

The term fire-brick is a comparative one, as all bricks to a less or greater extent are heat-resisting. For commercial purposes, however, bricks which have a fusing point under 2000° Fahr. would not be considered in this class. Those having a higher melting-point might be divided into lower-class fire-bricks, with a fusing-point of 2500° Fahr.; good fire-bricks, with a melting-point up to 2700° Fahr.; and high-class fire-bricks, with a melting-point reaching 3200° to 3300° Fahr. Experiments have shown that, for a really first-class fire-brick, the relationship of silica and alumina should be about two to one, with a total percentage of impurities of not more than 4 to 5.

The following are particulars of the chemical analysis of various classes of bricks.

	Silica.	Alumina.	Iron Peroxide.	Alkalies, Loss, &c.
West of Scotland	55·10	35·76	2·50	2·64
Stourbridge	67·00	25·80	4·90	2·30
Stourbridge	58·48	35·78	3·02	0·72
Newcastle	59·80	27·30	6·90	6·00
Local	62·50	34·00	2·70	0·80

When, however, determining the suitability of a high-class fire-brick, in addition to the above chemical analysis, there should be taken into account the physical condition in which the various constituent elements are found. The silica and alumina may be found as a silicate of alumina, or the silica may be found as free silica. Both silica and alumina are only fusible at extremely high temperatures; alumina being capable of resisting a temperature of about 3350° Fahr., and pure silica a temperature of about 3320° Fahr. Commercially speaking, however, neither material is found in an absolutely pure condition. As seen from the foregoing analyses, they usually contain a small percentage of oxide of iron and other impurities. In connection with these impurities, I cannot do better than quote the result of Richter's epoch-making experiments, which established that fluxes, lime, magnesia, &c., decrease the heat-resistance of a fire-clay in inverse proportion to their molecular weights. The most dangerous impurity is found to be magnesia, whose molecular weight is 40, followed (in order) by lime 56, soda 62, iron oxide 80, and potash 94. Titanium is also found in some clays; and its presence even in very small quantities has a most adverse effect on the fusibility of bricks.

As already stated, however, it has for long been recognized that chemical analysis is not an absolutely true index to the refractoriness of a brick, but that the geological or physical condition of the various component parts has also to be taken into account—clays of which the grains are coarse being found to be the best for heat resistance. But the heat-resisting power is not the only point that should be taken into account, as sometimes, even when fire-bricks with an extremely high melting or fusing point are used, serious trouble takes place in gas-works, caused by the shrinkage, softening, or contraction and expansion of the bricks with which such furnaces are built. It may therefore be of interest to refer to some of these points.

Shrinkage on different qualities of clays varies considerably during manufacture. After being moulded, and while lying on the drying floor, the greater part of the added or mechanical moisture is expelled, with a consequent shrinkage; but this contraction is further continued during calcining or burning of the brick in the kiln. The extent of the shrinkage during the calcining process depends entirely on the heat to which the furnace is raised; and unless the bricks are thoroughly and well fired, further contraction will take place in the furnace arch or pillar after the gas engineer has built them in, and thereby cause entire destruction of the brickwork. It should therefore be one of the first conditions laid down by gas engineers that only bricks which are burned at a high temperature should be accepted. Our kilns here are raised to a temperature of about 2700° Fahr., at which they are maintained for a considerable time, thereby entirely

eliminating shrinkage. Some clays which are extremely high in alumina are subject to such a large amount of shrinkage as to be almost unworkable; but this to some extent may be counteracted by the admixture of a large percentage of grog, or calcined ground brick. This admixture of grog is used to a greater or less extent in connection with all clays. Softening takes place very often in furnace-arches, and also in pillars subjected to high heats, where, though the brick shows no signs of fusing or melting, the softening point may have been reached, with the result of the settling down of the arch or the collapse of the boiler. In Scotland, gas engineers do not come much in contact with bricks which show a great expansion while subjected to intense heats. This defect is most plainly seen in bricks made in the Sheffield district, and in Welsh silica bricks. The result is that though having a high fusing and softening point, owing to the extreme variation of expansion or contraction, they are unsuitable for furnaces where rigidity is requisite.

Another point which sometimes causes failure of otherwise suitable material is want of care on the part of the brickmaker in drying and calcining, with the result that only the outside portion of the brick or block is thoroughly calcined—the inside showing a dark coloured mass. This is caused through the mechanical moisture not being completely driven off on the drying floor, or in the initial stage of burning in the kilns, with the result that the outside of the brick becomes calcined and prevents the inside being subjected to an oxidizing heat. Owing to the thinness of ordinary sizes of fire-brick, such a defect is seldom found in hand-made bricks; but it is one of the bad features of machine-made bricks. The danger, however, of such a defect taking place in large blocks is much greater; and gas engineers who require large-sized blocks should order these a considerable time beforehand, so that they may be thoroughly dried previous to being burned. In this connection, it is well to keep in mind that very large sized blocks are neither suitable nor economical from any point of view.

It has been a matter of complaint—especially among gas engineers—that fire-brick manufacturers have not applied themselves to the scientific side of their branch of manufacture so much as might have been done, especially in connection with analysis and tests for heat-resistance. I have no doubt that this aspect would have received greater attention had fire-brick yards been in the happy position of monopolists, such as gas-works are. Another point which has to be remembered is that tests for heat-resistance are of comparatively little value when conducted at lower heats than about 2700° Fahr.; and the trouble with the brick manufacturer in the past has been that scientists have not been able to devise methods for testing such high temperatures which could be continuously and economically used by fire-brick manufacturers. The introduction in recent years of the Féry radiator and similar types of pyrometers has somewhat simplified this matter. In our works, as tests for heat-resisting purposes, we have found it most economical, as well as reliable, to use Seger cones. These are small triangular pyramids of highly infusible earth, with certain graded melting points.

In the paper which Mr. F. J. Bywater read before the Institution of Gas Engineers in 1908, he complained that, while within the last twenty years there has been an increase of the working temperature in gas-works of about 200° Fahr., he did not think that the fire-brick manufacturers had, to a corresponding extent, increased the heat-resistance of their materials. This complaint may have some foundation; and it might be inferred that it is possible for a fire-brick manufacturer to increase the refractoriness of his clay at will, in the same way as the gas engineer during the last twenty years has improved his method of carbonization. Such inference, however, fails to take into account that fire-clay is a product of past ages; and, while differing somewhat from coal deposits in that it can be slightly improved by man (by such processes as weathering), still, like coal, it may be of good, bad, or indifferent quality, and no amount of treatment of a commercial character will make it otherwise.

I await with interest the report of the Refractory Materials Committee, which I suppose will be the results of experiments and tests of a certain number of refractory fire-clays.* If my supposition is correct, I do not think it would be wise for all fire-brick manufacturers to accept such a report, as each particular deposit of clay has its own peculiarities, which can only be discovered by exhaustive and continuous tests.

Discussion.

Mr. STEWART remarked that the subject had been under their notice, because of the communications in the Press upon it. He was there to learn what gas engineers wanted in the way of brick-making. If they did not agree with any of his theories, he should be most happy to hear their views, as he had not arrived at what he might call an ultimate analysis.

The PRESIDENT (Mr. Walter Dunlop, of Kirkcaldy) said one thing which struck him during the reading of the paper was Mr. Stewart's statement about making clear the nature of the work to be performed by the bricks ordered. This was a very reasonable position to take up. Not so many years ago, no account at all was taken of this. Simply, fire-bricks were ordered; and fire-bricks were the same for all purposes. But fire-brick manufacturers were progressive to such an extent that, if users told them the nature of the work to be performed they would produce an article for that special purpose. Another point made by Mr. Stewart was the giving of sufficient time in ordering goods. The best results would be obtained if they gave brick manufacturers plenty of time to get the goods prepared. It must be evident to them all that at least one fire-brick manufactory in Scotland was conducted on scientific lines, and in which their requirements were met in every way. He proposed a vote of thanks to Mr. Stewart for his paper.

Mr. W. GEDDES (Granton) thought it was a very reasonable claim which Mr. Stewart made, that orders should be placed well in advance of the material being actually required. He quite agreed that, with bricks for various portions of a setting, it should be specified which particular part they were required for. It stood to reason that a brick needed for a special purpose should be manufactured in a particular way. Mr. Stewart's opinions about hand labour were the general ones.

Mr. H. F. DORAN (Granton) asked Mr. Stewart's opinion as to the effect of the high percentage of iron in the Newcastle clays, in comparison with the percentage of oxide in the Scotch clays. With regard to the use of the Féry pyrometer, he had had some experience with this apparatus at Granton; and he would like Mr. Stewart's opinion upon it. He would re-echo the views of the gentlemen who had spoken as to the ordering of bricks in plenty of time. It was most desirable, in connection with the chemical composition of the bricks, that they should have plenty of time to dry. If they were quickly dried, the outside got hardened, which prevented the oxidizing of the material in the interior.

Mr. J. MITCHELL (Dundee) thought, with reference to German retorts, that too much had been said about them. If retorts manufactured either in Scotland or in England were put into a proper setting, and the settings properly watched, they would be found to be all that was necessary. Looking after the construction of the producer was a very important point in a gas-works. They should ask for the right kind of brick, and, when they got it, put it into the right place. Fire-clay goods should be ordered at the beginning of the year. If they obtained the material early, they would find that they had the whole summer in which to go ahead with the repairs. Could Mr. Stewart give them a comparison of the Scotch and the German clays?

Mr. STEWART, in reply, said that Newcastle clays were found along with the coal seams which abounded in that district; and the clay was what they called in the fire-brick world weak clay. They would understand the quality of it when he told them that they had, from the Bonnyside works, daily supplies going into the North of England, to users who had intense heats, and who found it profitable to buy first-class Scotch material, even if it cost double the price of local bricks. Iron mixed with potash seemed to him to be one of the greatest and deadliest foes of heat-resistance—at least, they found these two materials having the greatest effect on the heat-resisting power of fire-bricks. As regarded the Féry pyrometer, he was glad to find one in the gas industry who had begun taking—continuous, he hoped—records of the heat generated in his furnaces. The usual complaint received by the fire-brick manufacturer was that his bricks had given way in a certain part of the furnace; but when inquiry was made as to what heat had been generated in this particular portion of the furnace, there was an absolute want of knowledge. Were more careful and more accurate heat measurements taken of the different parts in gas-furnaces, fire-brick manufacturers would be able to supply for these particular parts bricks which would withstand the special conditions which were there found. In their own works, they had made experiments with Féry pyrometers; but, after very careful consideration, they found that their present system of using Seger cones was the best. Their furnaces, of course, differed considerably from those in gas-works. In gas-works furnaces, there was not the large body of material being calcined which there was in a fire-brick kiln. With a Féry radiation pyrometer, they would only ascertain the heat in the particular part of the furnace under observation; whereas Seger cones could be placed all over the kiln which was under fire, and careful examination made after the kiln had been fired. The cones being set with different graded melting-points, gave almost absolutely accurate results. He might say, however, that he was still looking for a perfect heat recorder which would at the same time be sufficiently economical to allow fire-brick manufacturers to adopt it. He quite agreed with Mr. Mitchell regarding German retorts. The *crux* of the question was the setting of the retorts, and the care of the gas engineer in the regulating of the heats. If this part of the work was carefully supervised, it would be found that English or Scotch retorts would last as long as those from anywhere else on the globe.

* The report referred to has been issued since the paper here reproduced was read. See *ante*, p. 839.—ED. J.G.L.

In the December number of the "Occult Review," Professor W. F. Barrett, F.R.S., has an article on the divining or dowsing rod. He examines at considerable length what evidence there is that will stand the test of strict scientific inquiry to show that the "dowser" is of any use in locating the site for a well. The conclusions the author arrives at after investigating many cases are, briefly, that those who really possess this curious faculty are rare, and that the explanation of the success of good "dowsers" is a matter for physiological and psychological research, though provisionally the working hypothesis of "unconscious clairvoyance" may be entertained.

WELLINGBOROUGH WATER-WORKS AND SOFTENING PLANT.

By E. Young Harrison, Assoc.M.Inst.C.E.

[Extracts from a Paper read before the Association of Water Engineers, Dec. 9.]

In October, 1870, the Wellingborough District Council purchased an acre of land on the side of a hill at Bushfield, 1½ miles north-west of the town, for a new water supply; and a well 9 feet diameter and 25 feet deep was sunk on the site. This well (No. 1) was never very satisfactory, owing to the large quantity of sand with which it was continually choked. In 1878, another well (No. 2) was sunk about 60 feet to the south of No. 1, when a comparatively abundant supply of pure and wholesome water was immediately obtained. No. 2 well is 35 feet deep, and brick lined; the lining being carried up 5 feet above the surface of the ground and rendered outside with cement mortar. The yield of water from this well is from 16,000 to 21,000 gallons per hour, depending upon the rainfall.

In 1899, with a view to supplementing the supply, new works were constructed at Hardwick, including a new well, catchment tank, and pumping-station. From 6000 to 13,000 gallons per hour are pumped by three-throw pumps, having 6¼-inch rams, 8-inch stroke, driven by a 24-B.H.P. gas-engine with suction-gas plant. The water is delivered to the circular tank at Bushfield to be softened and filtered.

In order to obtain an accurate regulation and measurement of this water on delivery to the new softening plant, a pump was provided in the Bushfield Well pump-house, capable of passing 8000 to 12,000 gallons per hour from the circular tank to the bell-mouth of the softening tanks as reuired.

In his report on the new scheme, the author pointed out the comparative advantages and disadvantages of electricity, town gas, suction gas, and steam respectively for pumping; but the members will be so familiar with these points that it is unnecessary to elaborate them here. The estimated working costs in each case, being, perhaps, peculiar to the locality in which the works are situated, may, however, be of interest for purposes of comparison with those obtained elsewhere. The figures were based upon a maximum output of 45 B.H.P. for an average working day of ten hours. The cost of labour is not included; for whatever power was installed, the wages-sheet would not be materially affected. Electricity, reckoning 0·9 unit per B.H.P. hour, at 1¼d. per unit, equals £2 2s. 2d. per day. Town gas, on the basis of 24 cubic feet (650 B.Th.U.) per B.H.P. hour, at 1s. 10d. per 1000 cubic feet, equals 19s. 10½d. per day. Producer gas, on the basis of 1½ lbs. of anthracite beans per B.H.P. hour, at 30s. 1d. per ton, equals 9s. 0¾d. per day. Steam on the basis of 5 lbs. of coal at 16s. 6d. per ton, per B.H.P. hour, equals 16s. 6d. per day. The figures would be correspondingly lower if it were possible to run the pumps at normal rate with a full and continuous supply of water; but this unfortunately is not the case. During a considerable portion of the year, the pumps and engines are often working at half-load.

The author, in his report, advised the erection of a new pumping plant to include a three-throw pump, capable of pumping 40,000 gallons of softened water per hour to the reservoirs, with gas-engine and suction-gas producer plant of sufficient size to provide motive power also for No. 1 well pump and the water-softening machinery; also that the existing pumps in the No. 2 well, should be kept intact as a duplicate pumping plant. The report was adopted; and in November, 1907, the new installation was completed. It has since given every satisfaction; and the Council's expectations have been fully realized.

The softened water pump is a horizontal three-throw ram pump, having cast-iron rams 10 inches in diameter by 15-inch stroke. The pump is driven by means of a 57-B.H.P. horizontal gas-engine. The gas-producer plant uses Welsh anthracite nuts. The amount of water available being variable, it was necessary to provide that the pumps should be able to pump 20,000 gallons per hour, or half the normal rate as required. This is accomplished by reducing the speed of the gas-engine 25 per cent., and throwing No. 3 ram out of action by closing the suction valve with a screw. The engine is started by compressed air; the apparatus consisting of a belt-driven air compressor, which charges a receiver up to 150 lbs. per square inch, while the engine is at work; the receiver holding sufficient air for some half-dozen charges.

In January, 1906, the author was instructed to report upon the softening works at Bushfield. The report clearly showed that the existing Atkins softening plant and the Soar filters were not only inadequate for the present needs, but were imperfect in mechanical detail, and that a new plant was required. The Council, on the author's advice, adopted the continuous system, with mechanical arrangements, devised and patented by Mr. C. J. Haines—a plant which, while operating on the same principle as the Atkins plant, was more easily adaptable to the existing site, buildings, and machinery, and involved a smaller initial outlay, as well as less maintenance costs, than any other system of water softening. [The author described the process; and then gave details of the filters, three in number, and of the Haines type.] Each filter is capable of dealing with between 10,000 and 12,000 gallons per hour, and contains an effective filtering area of 540 square feet, occupying a floor space of 8 ft. by 4 ft. [Details were next supplied of the cleaning apparatus, in connection with which the information was given that the average life of the filter cloths at Wellingborough is about nine months.] Two sets of cloths are provided for each filter; each set being in use for three months. Before the cloths are removed, they are steamed and left on during the night to thoroughly dry. They are then taken off, well brushed, beaten, and carefully packed away ready for further use.

Two regulating-pumps are fixed in conjunction with the Hardwick pump and well pump respectively; No. 1 being a 3½-inch diameter horizontal double-acting pump, and No. 2 (or well) regulating pump is also a double-acting one, 3¾ inches diameter.

The quantity of lime water required to reduce the hardness of the water from 33° to 14½° is found to be 13 gallons per 100 gallons of water softened.

The wash-outs to the cylinders, filters, and softening tanks are connected to mains discharging into large open pits. The top water when clear is drained off to No. 1 well. The deposit, after drying as far as possible, is barrowed about 20 yards immediately below the site. The accumulation is carted on to adjoining lands once a year at the Council's expense. A more favourable method of disposal might be found if the lime was not so greatly discoloured by the iron present.

The water is regularly tested by means of the soap test, and phenolphthalein is also used for the detection of free lime in the clear-water trough. During the seven days' test under the guarantee of the patentee (Mr. Haines), the hardness of the water at the reservoirs did not vary ½°.

Several appendices accompanied the paper. In the first it is stated that the capital cost of the new works at Bushfield was £5350, divided between softening plant, £3008, new machinery, including clear-water tank, £1700, additions to buildings, foundations, £642. The contract price for the reinforced concrete tank, 40,000 gallons capacity, was £315; the lowest alternative price for the tank in ordinary concrete was £434. The total saving on the two power plants for the first year's working, over the average cost of the two preceding years, amounted to £348; the cost of softening has decreased from 0·79d. to 0·66d. per 1000 gallons, through saving in cloths, lime, &c.; and on the amount pumped last year this equalled £45.

In the second appendix, it is shown that the total cost of softening per 1000 gallons, and reducing the hardness from 33° to 14½° is 0·660d., or ¾d. Dr. Thresh stated, in his report, "that the quantity of Buxton lime required to soften this water is 2·45 lbs. per 1000 gallons; but as it is impossible to get the whole of the lime in solution, 3 lbs. is about the quantity to use." The figure for lime is therefore satisfactory. If the weight of stones taken out of the lime mill is deducted, the amount per 1000 gallons is 2·73 lbs.

From the third appendix, dealing with power and fuel, it is gathered that the average load equals 36 B.H.P. The coal consumption under this load—*i.e.*, two-thirds full load, averages 0·94 lb. of anthracite per I.H.P., or 1·11 lbs. per B.H.P. hour. On reducing the whole pumping cost for the year to March 31, 1910, to one basis, the cost for fuel alone was 0·14d. per 1000 gallons raised 100 feet; the price of coal being 30s. 11d. per ton at the works.

The fourth appendix contains an analysis of the water by Dr. Thresh. In a note he remarks: The water is efficiently softened and is not deteriorated by its passage through the mains. The only change that has taken place is an increase in the temporary hardness, due to calcareous matters in the mains. The softening has reduced the hardness of the water in the reservoirs to within 2° of the permanent hardness.

Discussion.

Mr. W. Matthews (London) said he knew something of these works; and, in general terms, he was bound to say he congratulated the author of the paper very much on the thorough success he had made of them. The particular water he had to deal with was of an extremely difficult character; and possibly there was nothing like it in the country. He (Mr. Matthews) should have thought that, owing to the considerable quantity of magnesia in the water, and added to that the large amount of carbonate of iron, it would have been next to an impossible water to have filtered out with softening by the process of mechanical filters. However, the problem had been thoroughly tackled; and the result was an eminently good one. The water was over 30° of hardness, and it was brought down to 15½° at the end. The cost came out to about ⅜d., and this was considerably less than he (Mr. Matthews) would have dared to have estimated for if he had been starting the scheme. He should have thought it would have been ¾d., and that it might have run up to 1d. The author told them that the hardness of the water in the reservoirs during the test did not vary ½°. This was a good result, and was not usually obtained with mechanical processes. With regard to the coal consumption, under two-thirds full load it averaged 0·94 lb. of anthracite per indicated horse power. He should think that the anthracite was exceedingly good; and it was certainly an excellent result. The author gave them the amount of saving in coal of the two preceding years as equal to £348. He also showed that repayment and interest only amounted to £135; so that, by scrapping the old plant and putting in this new one, his Authority had saved £150 to £160 a year. This was one of the points of which notice should be particularly taken.

Mr. C. H. Roberts (Southampton) asked the reason for putting down the Hardwick pump. It appeared to him that the water in

the circular tank coming from Hardwick was at such an elevation that it would have discharged itself by gravity into the softening tank. It occurred to him that, instead of pumping into the softening tank, some other means might have been arranged for a definite quantity of softened water to go to the lime-water cylinders at the same time; and it also occurred to him that, instead of putting a pump there, a hydraulic motor worked by the difference in head between the circular tank and softening tank would have been sufficient to work the regulating-pump. With reference to the use of electricity, town gas, steam, and suction gas, the author remarked that the members were so familiar with the disadvantages and advantages of these different means of power for pumping, that he would not mention them. He (Mr. Roberts) for one would have liked to have seen some particulars of the disadvantages and advantages. Of course, with a small plant of this kind, steam was at a disadvantage; but he often thought that steam was unjustly compared with (say) suction-gas pumping plant, and for this reason: An old and obsolete pumping plant existed at a station; and it was certainly ready for scrapping, when an advocate of producer gas came along and said that, by adopting his system, there would be such and such a money saving. If, however, modern steam-pumping plant were put down, there would be very nearly the same amount of saving. The author stated that producer gas, on the basis of 1½ lbs. of anthracite beans per brake-horse-power-hour, at 30s. 1d. per ton, equalled 9s. 0¾d. per day, while steam, on the basis of ·5 lbs. of coal, at 16s. 8d. per ton per-brake-horse-power hour, equalled 16s. 6d. per day. It would be interesting to know if the author had definite quotations from first-class firms for a steam plant, because it seemed to him (Mr. Roberts) that 5 lbs. of good coal was a large consumption for a first-class modern compound steam engine. He should have thought half this consumption would have been sufficient. In addition, a considerable amount of capital would have been saved. In using a gas-engine, there was always the difficulty, which did not exist with a steam-engine, of varying the speed without loss of efficiency.

Mr. T. Molyneux (Stockport) remarked that some time since he described to the members a softening plant he had put down; and before leaving for the meeting, he got out some of the particulars as to the costs. In the last financial year, he softened about 218 million gallons of water, as compared with Mr. Harrison's 82 millions; and the cost worked out to 0·48d. per 1000 gallons, as compared with Mr. Harrison's 0·66d. Of course, his plant was larger than that at Wellingborough; and this might have something to do with the difference in the costs. On the other hand, his (Mr. Molyneux's) plant was not run to the full extent. If it had been, the cost would work out cheaper still. It was not only due to the plant that it was done so cheaply; but he had adopted certain arrangements which relieved him in regard to the cost of lime. His plant was not a continuous one; but he considered the one he had put in was superior, because of the absolute control of the whole of the work that the man in charge had. It had always struck him that the filter-cloths were a great disadvantage; in his own case, the work was done by sedimentation. Directly filter-cloths became efficient, they began to get inefficient. Using his process without filters, he had no complaints of lime going through; and, tested every morning, the results were practically identical.

Mr. A. B. E. Blackburn (Sunderland) agreed with Mr. Molyneux that there was great difficulty with filter-cloths. The author said they lasted about nine months. About a year ago, he (Mr. Blackburn) had the pleasure of going round the St. Helens Water-Works. When there, he was informed that the filter-cloths only lasted sixty days; and during that period they were taken out and washed three times. He should therefore like to know how it was that the filter-cloths lasted so long at Wellingborough. He also asked about the quantity of magnesia there was in the water (the chemical analysis given in the appendix did not state the amount); and how much of the permanent hardness was due to the magnesia, and how much to sulphite of lime. Another important question in connection with water softening was the sludge disposal. It seemed to him the carriage of the sludge was always a serious item. Some softening works were conveniently situated, with pits or big areas near at hand where they could deposit the sludge. But this was not always the case. He believed that a ton of sludge was made per million gallons of water softened, and the carriage on this would be really a serious item. Was anything included for this in the 0·66d.? It seemed to him the softening plant was much larger than was necessary to deal with the maximum daily consumption of water at Wellingborough. He further inquired how many men were engaged on the plant apart from engine pumping. He noticed that Dr. Thresh said in his report that there was an increase in the temporary hardness due to calcareous matter in the mains; and this suggested the question whether the softening process was really completed before the water entered the mains.

Mr. R. A. Blakeborough (Brighouse) asked, in connection with the question of the reduction of the permanent hardness, what degree of alkalinity the author found in the softened water. He agreed with Mr. Molyneux with regard to filter-cloths, and was rather surprised such good results were obtained at Wellingborough. It seemed to him that with quartz filters, better results still would be realized. After sterilization, they might get better results, as it was a difficult thing to get all the impurities out of the cloths by simply using a jet of water.

Mr. Molyneux observed there was one comparison he had omitted. It was that his softening plant cost £4851, against the author's £3008.

Mr. William Whitaker suggested to the author that a finished mineral analysis would be very useful.

Mr. Harrison, in reply, promised to supply a mineral analysis, as well as information as to the alkalinity. With regard to the Hardwick pump, he was of the same opinion as Mr. Roberts. As the water was delivered at a higher level than the water softening plant, one would have thought it could have been delivered to the latter by gravitation. But the patentees would not be satisfied with anything but pumping if they had to give a guarantee. He had one or two guarantees for particular measuring plant under which the makers would deal with the water under varying heads and in varying quantities. Though at first it seemed to be a foolish thing to pump water from a high level to a lower one, the Local Government Board Inspector saw that it was better to arrange it as required by the patentees; and the working cost of the pump was very small. The cost of the measuring apparatus would have been more than the cost of the pump. The advantages and the disadvantages of the various means of power, he hardly thought came within the scope of the paper. Their existing steam plant was a low-pressure one; and their buildings would not have accommodated steam plant. From the standpoint of building capacity, the plant adopted was the more economical. Mr. Molyneux had answered his own question as to the cost when he spoke of the amount of water with which he had to deal. It was obvious that the reason for softening the water was that without it was a most difficult water to use. As to the filter-cloths, they had just removed some which had been in use twelve months. They were employed three months at a time. After three months, they were taken off, steamed, and cleaned. This was done four times. Some of them shrunk; otherwise he believed they would go for a further three months. The size of the softening plant was accounted for by the fact that they only ran it a ten-hour day. There were three men on the works; and practically the time of one man was given to the water-softening plant. The reason the plant was adopted was that the mains were getting practically blocked up. One of the 4-inch mains became so coated that it had only a 2-inch bore through. The amount of deposit was being gradually done away with in the mains; and there was no new deposit. The bacterial report was not good; but though there was a large number in the water, they were simply water bacteria, and not at all harmful. Reverting to the question of the filter-cloths, they were steamed every week; and this was considered sufficient for sterilization. The water used for washing the cloths was run into the lime-pits, and then the top water was run off, and used over again. The cost of carting the sludge lime to neighbouring land was £30 per annum. This was not included in the figure he had quoted.

GAUGING AND RECORDING FLOW OF STREAMS.

By S. C. Chapman, M.Inst.C.E. (Water Engineer, Torquay).

[Extracts from a Paper read before the Association of Water Engineers on Dec. 9.]

The author presents this paper in the hope that it will promote the more general and systematic collection and tabulation of records relative to the available water resources of the country. That such a record is needed, none will deny; for the demands now being made upon water authorities to provide supplies sufficient for the ever-growing populations, and the more stringent conditions now imposed by Parliament in regard to compensation water, &c., render a wider knowledge of the actual yield of streams a matter of primary importance.

The usual practice of many engineers is to base their calculations upon the rainfall, making arbitrary allowances to cover the "three-dry-years" period, and allowing a further arbitrary amount for evaporation and absorption, with such variations to meet the local conditions as experience may dictate. In some instances, no doubt, a very near approximation to the actual available yield may be obtained in this way; but in most cases, reliance upon such calculations must produce very curious, if not unfortunate, results. The granite formation in Devonshire is an example of this. The rainfall here varies from 40 inches per annum on the east to 60 inches on the south and west, while one or two places in the centre have over 70 inches. The results of many years gaugings show that it is impossible to accurately estimate the flow off any one watershed from that obtained from others.

On the east, the Trenchford and Blackingstone Valleys, which drain the gathering-ground from which the Torquay supply is drawn, yield a minimum of 0·18 cubic foot per second per 1000 acres over the whole gauged area; while one particular stream, with a catchment area of 961 acres, has run as low as 0·12 cubic foot per second per 1000 acres. In this case, the average annual rainfall is 39·42 inches, over a period of 25 years. The intake works are 718 feet above Ordnance datum; and the ground rises therefrom to a maximum of 1127 feet, Ordnance datum—the average elevation being about 900 feet Ordnance datum. On the south-west side of the Moor lies the Plymouth gathering-ground, which covers an area of 5360 acres, and rises from 708 feet to a maximum of 1625 feet; the average elevation being about 1100 feet above Ordnance datum. The rainfall here is about

60 inches. From records extending over many years, the dry-weather flow has been proved beyond doubt to be 2,800,000 gallons per diem, or 1·06 cubic feet per minute per 1000 acres from 4885 acres. In the centre of the Moor lies the source of the Devonport supply. This is drawn from the West Dart, Cowsic, and Blackabrook. The land has an average elevation of about 1400 feet; and the rainfall for 30 years averages 71·47 inches.

From the above figures, it will be seen that in the matter of the dry-weather flow alone, there are some most astonishing returns which are very difficult to reconcile one with another. These differences do not appear to be less marked even in the case of adjoining streams. Both the undermentioned streams run parallel to each other; the geological and climatical conditions are practically identical; and the readings were taken on the same day in the month of June, 1893. River Meavy, with 4885 acres gathering-ground, yielded 1·262 cubic feet per second per 1000 acres. River Cad from 5700 acres yielded 0·392 cubic foot per second per 1000 acres. Taken over a single ordinary year, streams may show a very decided difference in yield even when the rainfall and other conditions are practically identical.

The annual yield of various watersheds and the percentage of the rainfall which reaches the streams are matters which require the most careful scrutiny, and are of vital importance to every water-supply scheme. By the courtesy of Mr. Frank Howarth, M.Inst.C.E., of Plymouth, the returns from the Burrator gathering-ground from 1902 to 1909 are here given. The rainfall is based upon the average returns from eleven gauges scattered over a gathering-ground of 5360 acres.

Year.	Annual Discharge off Watershed. (Gallons.)	Discharge in Inches of Rainfall.	Average Rainfall Recorded on Drainage Area. (Inches.)	Percentage of Discharge to Annual Rainfall Recorded.
1902	5,650,832,055	46·54	46·77	99½
1903	8,760,136,589	72·02	63·47	113½
1904	7,411,496,580	60·94	59·71	102
1905	5,260,648,956	43·25	45·64	94¾
1906	6,186,503,618	50·87	58·77	86½
1907	Incomplete	..	..	..
1908	4,844,161,126	39·83	46·20	86
1909	6,530,485,848	53·70	56·18	95½

The paper next included tables taken from the Torquay gathering-grounds—showing the annual rainfall, the annual discharge, and the discharge in inches of rainfall, together with the percentage of discharge to the rainfall, for the Trenchford, Blackingstone, Clampitt, and Kennick streams. A few figures from the table referring to the Trenchford Stream (gathering-ground, 961 acres) are all we can give here.

Year.	Annual Rainfall in Inches.	Annual Discharge in Gallons.	Discharge in Inches of Rainfall.	Percentage of Discharge to the Rainfall.
1902	35·47	532,360,880	24·68	69·6
1903	50·79	859,472,270	39·61	78·0
1904	38 15	574,143,400	26·78	70·2
1905	33·70	399,491,970	18·50	54·9
1906	35·28	437,129,700	20·07	56·9
1907	41·03	572,951,358	39·77	77·0
1908	32·39	317,038,349	17·49	54·0
1909	41·94	471,705,250	26·04	62·1
Average . .	39·42	499,955,099	23·37	59·3

The averages for the past eight and eleven years are furnished so that comparison may be made with the Plymouth table.

Year.	Annual Rainfall in Inches.	Annual Discharge in Gallons.	Discharge in Inches of Rainfall.	Percentage of Discharge to the Rainfall.
8 years . . .	38·59	520,536,647	25·29	65·3
11 ,, ...	39·18	530,061,534	25·34	64·7

A comparison between the records of rainfall and the flow of streams, both per annum and for the different seasons of the year, reveals many points of interest; while a comparison between the percentage of discharge to the rainfall for the various seasons is very instructive, and reveals the extent to which the flow in one season is influenced by the rainfall of the preceding season.

The effect of evaporation upon the flow of streams is often very marked, and the variations in flow between day and night during the summer months are entirely missed when the stream gaugings are taken at a stated period each day. In a stream which drains a large moorland area, these fluctuations are considerable in their amount, and make a material difference in estimating the dry-weather flow. An automatic recording instrument is absolutely necessary to keep accurate and continuous gaugings of streams. The difference between the returns worked out from readings which are taken at a stated time each day and those calculated from the recorder diagrams, generally agree fairly closely; but in some years there is a variation of as much as 10 per cent.—the recorder returns always being the lower. This is partly due to errors in reading the scale; but the principal reason is that, during the summer, there is a continually lessening stream, and the daily readings are generally taken in the morning when the stream is at its maximum flow. On the other hand, in times of flood, both in summer and in winter, streams often rise and fall very considerably during the 24 hours; and the recorder returns are then very much in excess of the daily readings. The author is of opinion that the records should be taken by means of a float situated in a chamber at one side of the stream, connected therewith by a pipe which can be shut off, if necessary, for adjusting the zero of the float. This would obviate any errors due to capillary attraction and allow of a vernier attachment for fine readings. The cost of gauge chambers and gauging apparatus depends largely on local conditions, and the nature of the work required of them; but, under normal circumstances, it should not be so large as to constitute a serious burden on any water authority.

The question often arises as to how far gaugings can be relied upon. Local circumstances vary so much that it would take a volume to explain and give examples of the many factors which have to be considered in various cases.

Discussion.

Mr. E. Sandeman (Derwent Valley Water-Works) pointed to the interest attaching to dry-weather flows from watersheds, in view of the effect on the storage capacity of reservoirs. He also emphasized how the character of the geological formation had a great effect on the dry-weather flow. The excessive dry-weather flow from the Burrator gathering-ground was, he believed, due to the decomposed granite covering the bottoms of the valleys. He was naturally curious when at Plymouth to find out how much water a cubic foot of decomposed granite would hold; and he found it would take up 18 lbs. of water. An interesting point about evaporation was the loss due to the heat of the sun. At one time, he (Mr. Sandeman) hardly thought that it would be noticeable; but, as a matter of fact, it could be both seen and registered. It had been generally imagined that evaporation was greater in dry years than in others; but the fact was that when there was less rain, there was less water evaporated. Speaking quite generally, he thought every water engineer should take all possible means of ascertaining the flow of streams in his vicinity; and personally he looked forward to the time when a central authority would see to these records being taken.

Mr. F. W. Hodson (Loughborough) thought it was an absolute misnomer to call the streams referred to in the paper granite watershed streams, especially after what Mr. Sandeman had told them as to the water receptivity of the disintegrated granite. He was astounded to see from the figures given in respect of the Burrator watershed that practically the whole of the rainfall which precipitated was given off again. During 1902, for instance, the percentage discharge to annual rainfall recorded was 99½; 1903, 113½; and 1904, 102. It was a most extraordinary watershed on which no evaporation, no loss whatever, took place over a period of three years. The figures in the paper all pointed to a watershed on which there must be a considerable amount of porous rock, because in no case was there a figure which went down to less than 45 per cent. of the rainfall. He (Mr. Hodson) had, like the author, found the same variation from day to night on streams gauged. This might be due to the effect of the sun; but he thought there could also be traced another effect due to the barometer. He remembered an interesting set of observations on the daily level of water in a well which had just been completed. When absolutely no water was being taken out of it, the level in the well was gauged, and, comparing with the barometer reading, they were able to find that the extra barometrical pressure sent water out of the strata to springs at a distance, and, when the pressure was reduced, the water-level rose again slightly, but did not attain its original level until there was a period of rainfall again.

Mr. C. Clemesha Smith (Wakefield) believed that the gauging of streams would become of greater importance in the future than it had been in the past. Hitherto the amount of compensation given to streams had been arrived at by a method which, though well tried, was after all purely empirical, and was liable to serious error. He knew of a gathering-ground 5000 acres in extent, partly in limestone and partly in shales and grits. Some 3000 acres was limestone. It was gauged for a particular period; and the rainfall was over 9 inches, with a yield of 2·7 inches. On the remainder of the area (2300 acres), the rainfall was only 7·38 inches, and the yield 4·3 inches. With a smaller rainfall, twice the quantity of water was yielded. Had they arrived at the compensation water by the ordinary method, the millowners would have got a great deal more than their proper proportion of the rainfall. The only way to his mind to get really accurate results was by gauging the streams.

Mr. Easton Devonshire (London) remarked that, as a member of the Water Areas Statistics Committee, he thought that the suggestion in the first part of the paper, as to the collection of statistics, was most valuable. He hoped the paper would set an example, and develop the installation of recording apparatus which would enable information from the whole country to be placed at the disposal of the Association, and of water undertakings generally.

Mr. R. H. Wyrill (Swansea) said that in most of the larger water-works, no doubt careful records of the rainfall and of the gaugings of streams were kept. But as these in many cases had entailed considerable time, engineers had generally kept the results as being valuable only for their own works. Again, as considerable expenditure had to be incurred in obtaining the records, it was often held they were the property of the person

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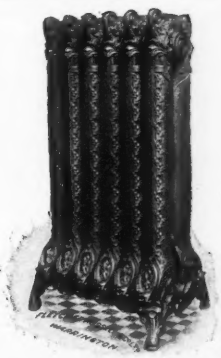

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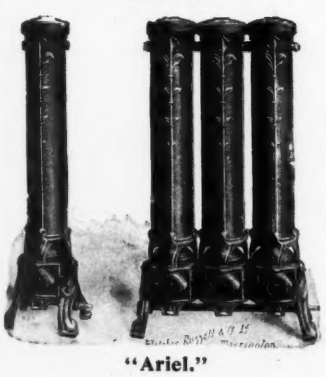

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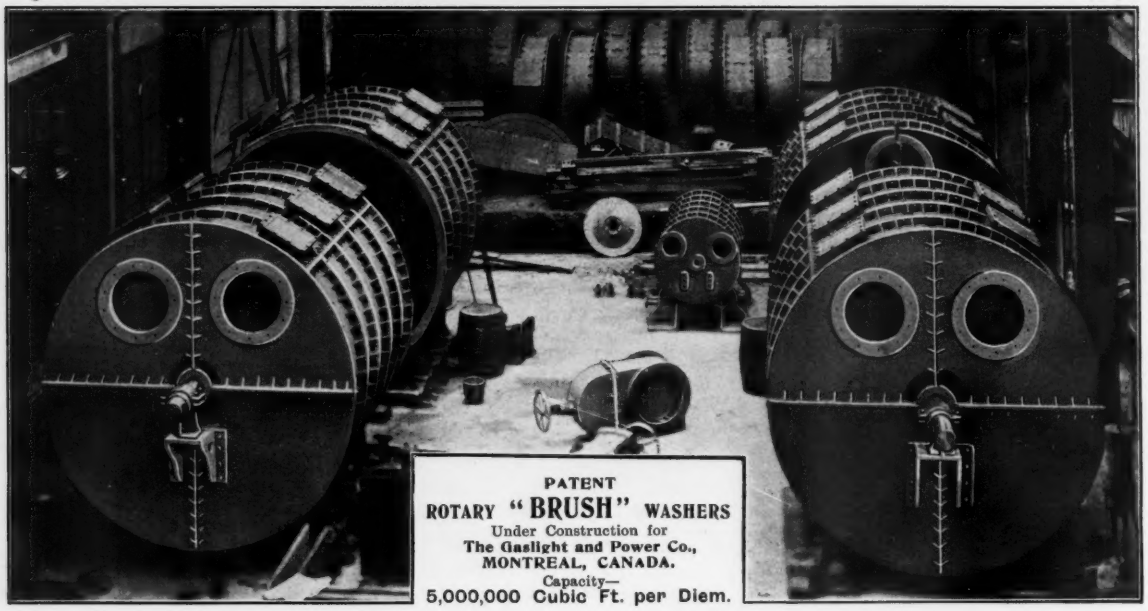
Whitestone Ironworks, HUDDERSFIELD. London Office: 11, Victoria Street, S.W.



Repeat Orders for Machines of the Type shewn above Recently Received from: THE ORIENTAL GAS COMPANY, CALCUTTA; THE IMPERIAL CONTINENTAL GAS ASSOCIATION, BRUSSELS; WALLASEY, U.D.C.; LUTON GAS COMPANY, &c., &c.

ECONOMICAL GAS APPARATUS CONSTRUCTION

MERRIFIELD-WESTCOTT-PEARSON PATENTS.

WATER-GAS PLANTS COMPANY, LTD.

19, ABINGDON STREET, WESTMINSTER, S.W.

Telephone: VICTORIA 39.
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or the authority incurring the expenditure. If, however, all the records were published, or were capable of being examined, the subject of the relation of rainfall to the flow of streams would be much advanced. The records given in the paper were valuable, but were restricted to a gathering-ground on granite formation; and this formation was comparatively small in extent. It was to be hoped that other engineers would be induced to produce their gaugings on other geological formations for purposes of comparison; for it was well known that the quantity of rainfall and the fluctuation of the volume or rate of discharge varied very much not only with the elevation, slope, area, and shape of the gathering-ground, but also with the permeability of the geological formation. Some gathering-grounds were largely formed of water-tight material which prevented percolation, and rapidly shed the rainfall into the streams, causing relatively heavy floods. Other formations allowed a considerable percolation which, in the first instance, absorbed and moderated the floods, but were productive of a high dry-weather flow. In his view, it would be much better to form an opinion of the probable yield of a source than rely solely on rainfall returns. It was not the rainfall, but the available rainfall, or the flow of streams, that was of greatest value. He commented on the importance of studying maximum flows, and urged the installation of recording rain-gauges in conjunction with automatic recorders on the stream discharge—the effect of different rates of rainfall being then directly shown in volume on the stream recorder. He had a combination of this kind in operation at the Crays reservoir of the Swansea Water-Works; and the results were most instructive. In regard to the returns for Burrator as given in the paper, in two cases there was more water shown in the stream than was indicated by the rain-gauge. This was probably due to the rain-gauges not representing the actual rainfall over the whole of the gathering-ground. The great variations he observed at the Swansea Water-Works showed the importance of not trusting to rainfall returns only, but the necessity of taking and preserving stream observations.

Mr. T. Molyneux (Stockport) also directed attention to the variable yield of neighbouring gathering-grounds, and said he believed that the compensation water they had to give would not be of the amount it was if they had fuller information.

Mr. R. Askwith (Weardale and Consett Water Company) pointed to another difficulty connected with this question. He said that one was in the habit of speaking of a "gathering-ground;" but very often water passed underground from one gathering area into another, and rose to the surface as springs. This might in some cases account for the yield being greater than the rainfall.

Mr. F. W. M'Cullough (Belfast) also illustrated from his experience how much, in relation to yield, depended upon the character of the gathering-ground—the covering, as well as the subterranean formation—and, if there were hills, their slopes, whether they were precipitous or otherwise.

Mr. H. E. Stilgoe (City Engineer and Surveyor of Birmingham) remarked that he did not think there was any great difference between them as to the quantity of rainfall in any one year not being comparable with the quantity flowing off in the streams. Looking at the table in the paper regarding the Burrator gathering-ground, it would be seen that in the years 1902, 1905, and 1908, the rainfall was much the same, while the percentage discharge to the annual rainfall did not at all compare. Much depended upon the intensity of the rainfall, and the condition of the surface of the ground at the time.

Mr. W. Terrey (Sheffield) emphasized the value of statistics like those in the paper. In a case where he was closely associated, owing to the lack of reliable data, a large quantity of compensation water was granted by Parliament, which they found, now they had recording-gauges, was quite equal to one-half the flow of the available yield of the watershed. Had there been in those days some carefully compiled statistics, such a mistake as this would not have been made; and it was exceedingly difficult to rectify statutory obligations of this kind when once imposed. Not only were there great variations of yield by watersheds owing to their difference in character, but the yield of the same watershed varied greatly one year with another, and one month with another, owing to the prevalence of high winds, sunshine, and other causes. In connection with the Sheffield works, they had not only introduced recorders which gave them the exact quantity of water flowing into the streams, but also the quantity that was lost owing to winter floods. He described the very complete system that his department had established, to furnish information in this connection.

Mr. Chapman, in his reply, instanced the importance of records as a guide in the construction of works. A few years ago, he was interested in the construction of a reservoir. There were no records; and the question at once arose as to the size the culvert should be to take off the flood water during the construction of the works. The only thing he could do was to refer to another gathering-ground where floods had been measured. The only gathering-ground in the neighbourhood was that at Plymouth on the granite formation. But this gave results which their own gathering-ground had never been able to give. He put down recording-gauges in order to test the floods during the construction of the works; and had he known then what he knew now, he would have been able to cut down the size of the culvert to one-half its diameter, and saved from £6000 to £7000. In the construction of works, to have to assure rainfall and discharge was a very uncomfortable position to be in; and it was this uncomfortable position that induced him to bring the paper before the meeting. He had not the slightest doubt as to the correctness of the Burrator gathering-ground figures to which frequent reference had been made during the discussion. Rule-of-thumb methods should no longer obtain among water engineers; and he hoped there would in future be a universal tabulation of actual facts.

REGISTER OF PATENTS.

Locking Cash Receptacles to Coin-Freed Gas Apparatus.

Schönfeldt, F., of Königsberg, Germany.

No. 20,989; Sept. 14, 1909.

This device consists in the cash receptacle being locked on to the meter by means of the mandrel of the lock itself with the aid of a key of the bramah type. By this combination with a stop-device and a tumbler, it is impossible for any unauthorized persons to open the lock without the key or without using violence.

Money Box for Prepayment Gas-Meters.

Ainley, L., of Newcastle-upon-Tyne.

No. 28,644; Dec. 7, 1909.

This invention is intended to provide, "in a simple yet an effective manner," an attachment having for its object "the prevention of robberies from prepayment gas-meters and the diminution of the consequent expense involved after such robberies in the fixing up or repairing of the money box and staple attached to, and forming part of, such gas-meters."

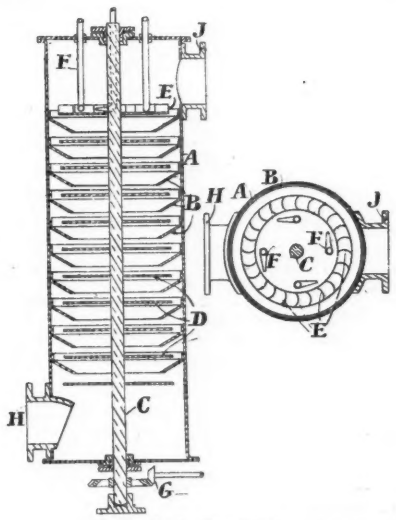
The device consists of a plate about 2 inch by $2\frac{1}{2}$ inch by $\frac{3}{16}$ inch thick, with a vertical slot in it, and a staple attached to the plate on the left side of the slot, approximating in size to the staple attached to the money box. The plate is placed on the front of the money box. The staple attached to it passes through the slot before referred to; the staple of the money box and the staple of the plate being flush. The padlock is passed through both staples, thereby making more difficult the pulling of the staple of the money box from the box. On the underside of the plate is a portion hollowed out to allow the plate to lay flat on the front of the money box.

Cooling and Washing Coal Gases.

Whittaker, E., of Levenshulme, Manchester.

No. 27,158; Nov. 23, 1909.

This invention has for its object to provide means to cool the gas and at the same time to wash out any suspended matter or impurities by providing a cylindrical chamber (fixed, for preference, upright) to the walls of which, on the inside, are attached, at suitable distances apart, a number of plates in the shape of inverted truncated cones or tundishes, having an inclination from the cylinder walls in a downward direction towards the centre or axis of the cylinder, but terminating some distance short of it, so as to leave an opening for the passage of the gas and liquid, as shown.



Whittaker's Gas-Washer.

In operation, water is forced through the jets or nozzles F against the impeller blades E, giving (or assisting in giving) to the rotor, which is formed by the central shaft, and its attached discs D, rotary or revolving motion. After leaving the blades, the water is thrown, by centrifugal action, across the intervening annular space which lies between the outer edge or periphery of the disc and the walls of the cylindrical casing in a thin film or curtain, through which the gas must flow. After striking against the walls of the washer, the water runs by gravitation down and across the upper surface of the succeeding inverted truncated cone-shaped plate B, again forming another film or curtain as it falls across the space that lies between the inner edge of the plate

and the next or following shaft disc. As the water falls on this second disc, it will be again whirled, by the centrifugal action set up by the revolving disc upon which it has fallen, across the intervening annular space lying between the outer edge of this disc and the washer wall in another film or curtain. After striking against the wall, the water will run down and across the upper surface of the next following inverted truncated cone-shaped plate, and so fall on to the next following shaft disc—this action being repeated any required number of times.

The gas enters at H, and then, passing upwards, is made to flow through each successive opening, and the films of water thrown across such openings, until it reaches the outlet pipe J. The water and impurities as carried over are drained away from the bottom of the apparatus in any convenient manner.

Vertical Retort Settings.

GIBBONS BROTHERS, LIMITED, MASTERS, R., and VAN MARLE, M., of Dudley.

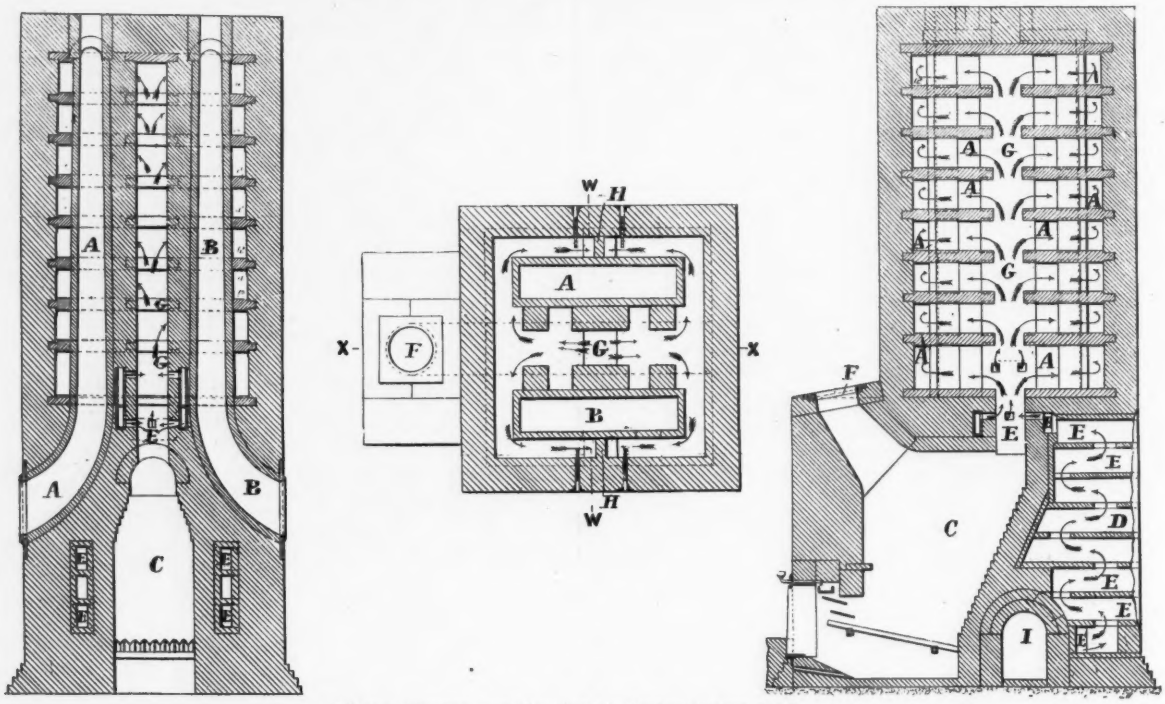
No. 27,291; Nov. 23, 1909.

In the type of vertical retorts to which this invention relates, the coal to be distilled is fed into the top (either continuously or intermittently), and the coke remaining after distillation passes away, either continuously or intermittently, from the open bottom of the retort at one side.

Previously, the patentees point out, it has been proposed in connection with vertical retorts that the setting which has a combustion chamber combined in it should be divided into compartments by horizontal partitions and provided with means for delivering and separately controlling the supplies of secondary air and gas to the various parts of the combustion chamber in proximity to the passages leading from the combustion chamber to the compartments; separate regenerators being provided for the exit of the waste gases from each of the compartments—the setting being also provided with means for separately controlling the draught through the regenerators from each compartment.

It has also been proposed, when settings for vertical retorts comprise a number of superimposed heating chambers isolated from each other by horizontal partitions, that each of the chambers should be supplied with streams of secondary air and producer gas previously mingled and ignited in a separate combustion chamber, into which chamber the producer gas enters through ports of an area adjustable by movable dampers; the streams of ignited gases travelling horizontally through the heating chamber round two or more retorts in the setting.

According to the present invention, the gas-producer is combined in the same structure as the retorts, and is provided with a vertical upcast shaft between the retorts and up which the gases from the producer rise; the secondary air meeting the gases as the latter rise out of the producer, "which are thereby thoroughly combusted." The combusted gases then rise straight up the middle of the setting and branch off at each side into and through the various horizontal compartments. In addition, the dampers are so arranged as to control the gases flowing out of the setting; "the whole ensuring slow combustion and enabling



Gibbons, Masters, and Van Marle's Vertical Retort Setting.

the retorts to be heated uniformly through their length." The heat can also be diminished or increased in parts as may be found necessary in order to obtain the best results.

The illustrations show a front sectional elevation of the proposed setting taken on the line W of the plan; also a sectional side elevation of the setting taken on the line X.

In carrying out the invention, the vertical retorts are (by preference, although not necessarily) arranged in any number of pairs in a setting—say, for instance, one pair as illustrated, lettered A B. They are by preference of large size (say) for instance, 16 feet high and 9 feet wide by 1 foot deep from front to back inside at the bottom and 9 inches deep from front to back at the top, and of rectangular cross section when viewed in plan. The setting also (by preference) comprises the gas-producer C and the regenerator D for heating the retorts, though the gas for heating the retorts may be supplied from a separate source. As stated, the retorts are, as usual, of a gradually increasing area from top to bottom, so as to facilitate the discharge of the coke. The gas-producer C and the regenerator D, when combined with the setting, are arranged underneath the retorts, with the secondary air passages E in the regenerator arranged between, and heated by, the spent-gas flues—of suitable construction.

The pair of retorts are arranged back to back, with the lower parts at opposite sides of the setting. The charging mouth F of the producer can be conveniently on the third side of the setting—that is, the side which is at right angles to the retort outlets. The retorts are arranged at a convenient distance apart; and the wider walls are supported by vertical brick piers or blocks and by horizontal tiles forming a series of floors or partitions and heat flues between the tiles, at certain distances apart, one above the other between and around the retorts, and between the retorts and the outer walls of the setting. At the centre of the setting between the retorts is an upcast passage G, at the bottom of which the mixed gas and air in combustion enter from the gas-producer and the regenerator, and pass up and into the heat spaces between the floors. At the two opposite sides of the retorts, there are two downcast passages with the divisional vertical wall H between them, so that each of the passages communicates with the heat spaces and leads away the spent gases to the regenerator, and so on through the regenerator to the main spent-gas flue I leading to the chimney stack. Thus, between every pair of floors formed by the tiles, the heat from the flue G passes between the retorts and round both retorts to the opposite sides and then down the outlets to the spent-gas flues. The outlets are each regulated by a separate damper; so that the heat of the retorts "can be regulated to a nicety as can be found most advantageous for the distillation of the coal." If the various retorts are charged on the continuous system, then, by regulating the dampers, a greater heat is obtained at the upper parts of the retorts than at the lower parts; but if the retorts are charged on the intermittent system, then the outlet dampers can be so regulated to give uniform heat through the retorts if desired.

Manufacture of Illuminating and Heating Gas.

BURTON, W. A., of New Cleethorpes.

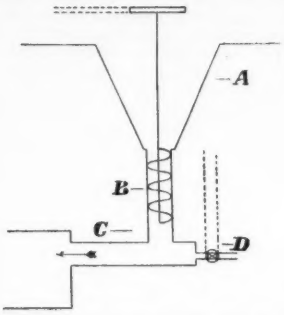
No. 27,517; Nov. 26, 1909.

This invention is to provide for the continuous or intermittent introduction of comminuted coal into a gas-retort during the process of carbonization, "in an atmosphere of gas—the necessary force for the introduction being derived solely from gas under pressure, in contact and mingling with the material to be distilled and the gases present in the retort." The gas used for the introduction is "water gas, or any fixed hydro-carbon gas in the absence of steam or air."

The inventor has the knowledge (he says) that it has been previously proposed to provide a jet of steam or gas in the pipe leading from a supply hopper to an inclined retort, in order to assist the pulverized coal in its passage through the retort—see patent No. 915 of 1885.

The apparatus used, as shown in the accompanying sketch, consists of a hopper A to contain the coal to be distilled, provided with a worm feed B, which delivers to a T-piece C, provided with a connection for gas under "high pressure," controlled by a valve D, which is capable

of being revolved by gear in such a manner that a blast of gas may be admitted at long or short intervals "as may be suitable to the material to be distilled." At the opposite end of the T-piece a connection with the retort is provided.



Burton's Continuous or Intermittent Chargers.

A valve (not shown) may be provided on end of the worm feed, and actuated in such a manner that, at period of blast (when high pressure valve is open), the hopper and feed shall not be in open communication with the T-piece, or the hopper may be provided with removable gas-tight lids.

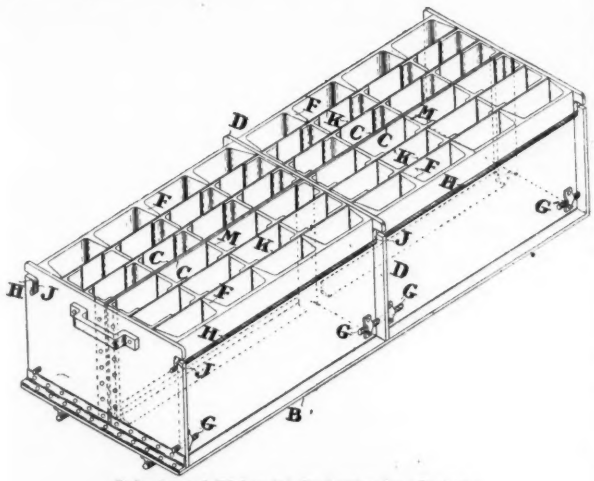
Carbonization of Coal.

PRINGLE, R. W., of Richmond, and RICHARDS, L. S., of Ravenscourt Park, W.

No. 27,828; Nov. 29, 1909.

This system of carbonization refers to a removable container adapted to be introduced into a retort and to be withdrawn therefrom. The object of the invention is to provide an "improved means for transmitting the necessary heat to the fuel to be carbonized and the consequent reduction of time required for carbonization."

The apparatus employed comprises a coal container provided with side-pieces and partitions or conducting plates adapted to subdivide the charge in such a manner as to allow the heat to be transmitted to every part of the mass by conduction. The thickness of fuel through which the heat has to penetrate is thus reduced to a minimum. The container is open-topped, and is divided by longitudinal ribs or dividing walls into a series of longitudinal open-topped compartments for the material to be treated; and the ribs are so arranged as to form compartments of tapering section to allow the residual coke to be easily discharged. The container may be run into and out of the retort upon rails laid in the retort; and in some cases a plurality of such containers may be disposed in one retort.



Pringle and Richards' Carbonization System.

The ends of the container are (as shown) attached to a bed-plate B. C are the longitudinal division plates, and D is a transverse division plate. The sides, provided with dividing ribs F, are hinged to the end plates and to the division plate D at G. H are rods adapted to lie in bayonet slots J for the purpose of keeping the hinged sides in position. K are movable conducting plates fitted with partition pieces M.

In this way, the coal is subdivided into separate small charges "in such a way that the distance through which the heat has to be transmitted through the material itself is well within the distance which will allow effective distillation to take place in a reasonable time, and, moreover, the time occupied in the operation is materially reduced."

In operation, the material is charged into the container, which is run into the retort. The retort is then sealed, and a temperature maintained within the desired range for a period of time depending on the nature of the products required. The container is then withdrawn, and the charge is cooled or quenched.

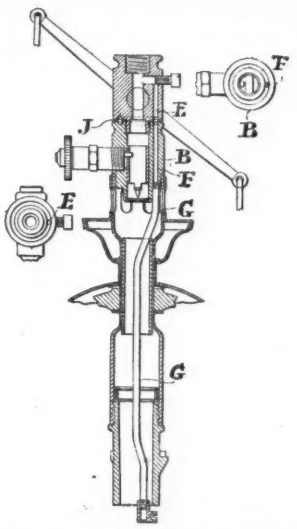
With apparatus thus made (the patentees assert), "the production of a smokeless fuel containing a high percentage of volatile matter becomes practicable in ordinary gas-works settings, whereas with the ordinary method of charging gas-retorts a uniform fuel of this description cannot be produced, as a layer of non-conducting coke is formed next to the retort walls; thus preventing penetration of the heat to the centre of the fuel. With the low temperature required for the production of smokeless fuel, this becomes an insuperable difficulty, as before the centre of the charge has reached the required stage of carbonization, the outer layers are hopelessly over-carbonized. By the introduction of apparatus made in accordance with this invention, which divides the fuel into thin sections, the low heat required to produce smokeless fuel can be successfully employed, and the time required for carbonization is greatly reduced."

Burners for Incandescent Gas Lighting.

FALK, STADELMANN, AND CO., LIMITED, and ELLIOTT, G. W., of Farringdon Road, E.C.

No. 30,066; Dec. 23, 1909.

This invention relates especially to burners of the inverted type provided with a bye-pass arranged within the burner-tube; the object being to provide for such a bye-pass when a regulator is employed.



Falk, Stadelmann, and Co., and G. W. Elliott's Incandescent Burner.

A passage E is formed in the body of the cock through which the gas for supplying the bye-pass flows, and a corresponding passage is formed in the regulator B. G is the pipe which conveys the gas from the passage F to the mantle. Grooves are formed in the adjacent surfaces of the cock (as shown in the underside view of the cock and a plan view of the regulator), which together form between them a channel through which the gas can flow from E to F, notwithstanding that the two passages are not in actual alignment. J is a packing-ring between the cock and regulator, and having formed in it a series of openings to allow the gas to pass from groove to groove.

Controlling the Supply of Gas to Burners.

KEITH, J. & G., of Farringdon Avenue, E.C.

No. 30,387; Dec. 29, 1909. No. 11,269; May 6, 1910.

The combined specifications relating to this invention refer to devices for regulating the pressure of the gas supply to burners—more particularly to burners which are used in railway carriages or the like, and which are supplied with gas at high pressure from storage cylinders carried on the carriages. The devices are of the kind in which a casing is provided with a hollow inwardly projecting member affording an inlet connection and provided with a valve seat for the reception of a valve carried by a stirrup secured to a diaphragm which is loaded by an adjustable spring.

Gas-Fires.

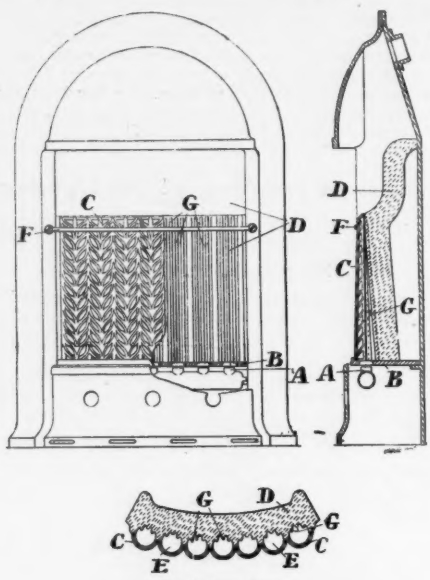
YATES, H. J. (John Wright and Eagle Range, Limited), of Birmingham.

No. 493; Jan. 8, 1910.

To carry this invention into effect (illustrated, p. 862), the burner is constructed as heretofore with a number of nozzles A, and over the nozzles is secured a tray B for supporting the "radiants" C, which are preferably constructed from refractory or incombustible material to "a corrugated or equivalent form with irregular apertures similar to those provided in the ordinary radiants." Each corrugation forms approximately one-half of a flame-enclosure. At the front, the radiants present the appearance of a number of vertical channels corresponding to the positions of the flames from the burner. The fire-brick back D is correspondingly shaped to form the complementary portions of the flame enclosures. As will be seen, the cross section of each flame-enclosure E is of approximately circular form; and a burner-nozzle is provided opposite the lower end of each enclosure. For retaining the radiants in position, a single bar F, secured across their upper edge, or an equivalent device, is preferably employed, so that the front of the radiants is left as completely exposed as possible.

To obtain an increased heating effect from the flames, the portions of the surface of the back exposed to the flames are ribbed or roughened. In the fire-brick back shown, vertical ribs or ridges G are formed on the surface of each groove or corrugation.

The patentee then remarks that "by surrounding each flame with



Yates's Gas-Fire.

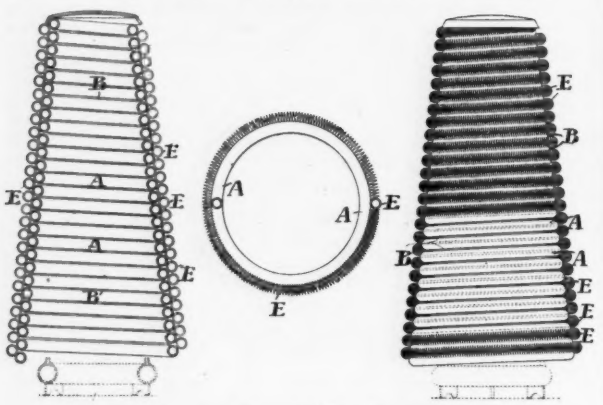
refractory or incombustible material as described—viz., by forming the rear portion of the surface exposed to the flame in or by the back, and the front portion by the detachable radiant which abuts against the back—the occurrence in the fire of parts which do not usefully contribute towards the radiation from the front of the fire is largely reduced, and the heat generated is utilized with greater efficiency than in fires constructed as heretofore."

Water-Heaters.

PARKINSON STOVE COMPANY and BARRALET, T. E., of Birmingham.

No. 4524; Feb. 23, 1910.

This invention relates to water-heaters in which the water to be heated is passed through a spirally-wound coil of piping, which is subjected to the action of the hot gases from the burner passing up through the interior of the coil from the lower open end and being caused to pass out through the spaces between the different convolutions.



Parkinson and Barralet's Gas Water-Heater.

In the illustration, the front elevation of the heater is shown with the heat conductor partly broken away.

The piping A through which the water passes is wound spirally into a conical coil (the smaller end being at the top), and the convolutions are separated from one another by small spaces B. A burner is arranged below the lower open end of the coil, while the upper end is closed by a cap forming a baffle-plate; so that the ascending hot gases are compelled to pass out through the spaces between the different turns of the coil. Over the outside of the latter, a length of coiled wire E is wound spirally, so as to lie between, and make contact with, each pair of adjacent turns or convolutions of the tube A, and thus cover the spaces through which the gases pass out. The issuing gases thus impinge upon, and pass through, the coils of the heat conductor, so as to abstract or absorb a large proportion of the heat, and conduct it to the walls of the adjacent turns of the coil of piping with which the conductor is in contact. The whole arrangement is, of course, enclosed by a suitable casing.

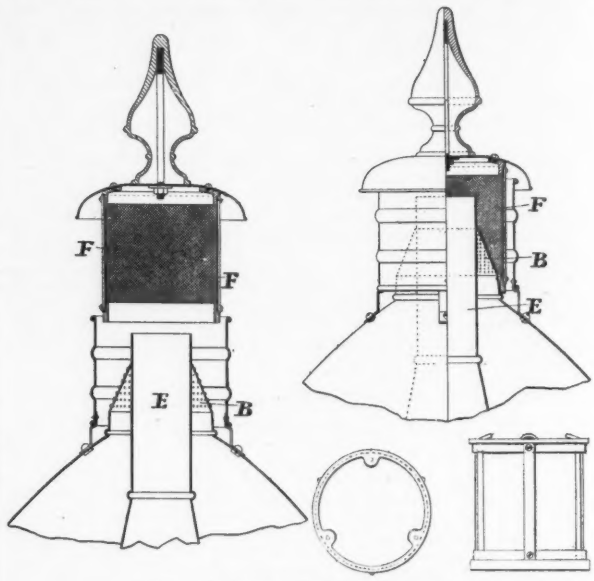
Insect-Proof Gas Lanterns.

GLOVER, R. B. G., of Edmonton, N.

No. 640; Jan. 10, 1910.

This insect-proof gas-lantern is shown, first, with the hood and gauze cylinder disconnected; then with the parts assembled, and showing a plan and a side elevation of the device for carrying the gauze cylinder.

The top of a lamp has a perforated cone B with parallel or slightly conical walls at the lower part; the perforations being made from the inside and in such a manner that the burrs of metal stand up on the outside of the cone. The cone has an open top in which the chimney E fits tight. A perforated or gauze tube F is positioned in the neck of the lamp and surrounding the cap B; the tube being held between two rings connected by the distancing bars I. The top ring has lugs for connection to the hood of the lamp; and both rings have recesses for receiving the tube F, which is closed at the top by the hood. The bottom ring of the cylinder F fits the bottom of the perforated cone B; and (with the hood) it can be readily removed from within the neck of the lamp, so that the cylinder and cone can be easily cleaned.



Glover's Insect-Proof Gas-Lantern.

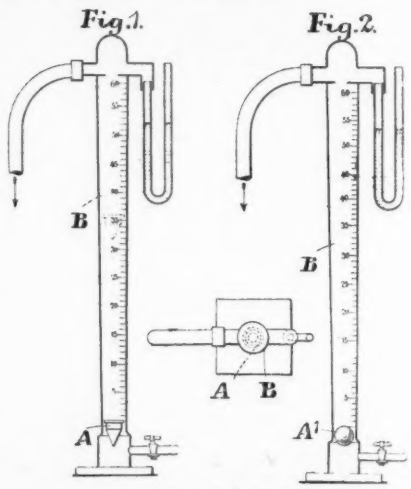
The products of combustion pass up the chimney E, and out at the upper part of the cylinder F; while the air to support combustion passes in at the lower part of F, and then through the perforated cone B into the lamp.

Measuring Gas.

INHOFFEN, R., of Aix-la-Chapelle, Germany.

No. 12,857; May 26, 1910. Date claimed under International Convention, Jan. 25, 1910.

In the patent No. 19,767 of 1909, apparatus for measuring gas was described, in which the gas is measured within a vertical, conically expanding, transparent tube (provided with a division scale) by the position of a float, to which rotary movement is imparted by the gas passing through passages of the float. The present invention relates to apparatus of this kind, in which a rotary float is employed within a conically expanding tube; the object being "to obtain an equal distribution and a smooth, steady passage of the gas at the point of the float." According to one form of the invention, this object is attained by employing as the float, or in connection with the float, a cone serving as a guide for the gas; whereas in a second form, a body of globular or (say) oval shape is used as the float.



Inhoffen's Gas-Measurer.

According to fig. 1, a cone A is provided in the circular glass tube B (expanding upwardly); the cone being lifted by the pressure of the issuing gas and serving to obtain an equal distribution of the gas. The tube is provided with a scale by which the amount of the issuing gas can be read off "per unit of time" at any given time, by the position of the floating cone beside a division line.

In fig. 2, the same object (of obtaining a rotary body with equal distribution of the gas) is attained by the provision of a ball A^1 within the interior of the circular upwardly expanding glass tube B.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Carbonization in Vertical Retorts.

SIR,—From time to time I have read the following expressions in the "JOURNAL" on this matter: (1) "Putting a few more ideas into the melting pot." (2) "Carbonization at the present day [June, 1909] is in a condition of flux." (3) "That was the problem; and it would require a great deal of work before they could successfully solve it." (4) "From the point of view of those who wanted to know what was the best plant to adopt for the future, they were all in a state of great perplexity." (5) "Carbonization is now [1909] in the transition stage." (6) "They had not reached that stage of development in which it was thought wise to incur the expense of making very costly tests." And now [1910] (7) "The carbonizing maze." (8) "Constants and variables in the destructive distillation of coal." In view of this, it seems strangely strange that lastly we should have suddenly sprung upon us: (9) "The confirmation of the carbonizing theory, as the outcome of Dr. Colman's lecture recently delivered in Manchester. The able manner in which Dr. Colman discusses carbonization is distinguished by a clearness in exposition peculiarly his own."

To those who have been—or are at present—engaged in vertical retort carbonization (a process "come to stay"), Dr. Colman advances the theory that "half the gas finds its way through the coke." I presume he means the outer crust of already carbonized coal next to, and adhering to, the walls of the retort.

Against this theory, he gives the views of Dr. Bueb as follows: "The gas evolved on carbonization will seek the way of least resistance; and so, passing into the middle of the retort, this core serves as an exit passage."

By long experience and careful observations, I can only repeat that I am in full accord with Dr. Bueb's views; and, by way of confirmation or otherwise, it would be highly interesting at this point of time if Dr. Bueb would give us his observations on his later experiences.

Without at present making any particular reference to either of Dr. Colman's diagrams as shown at his lecture, I am satisfied to repeat an opinion I gave (and published) some four years ago—viz., "The transmission of heat from all points of the circumference towards the centre of the retort tends to maintain a gentle expansion—keeping the coke pressing against the sides of the retort until such time as there was nothing left to expand; then, for a sudden contraction to take place, leaving small spider-web-like bridges across a diameter of what was formerly a plastic bubbling mass giving up its last gases—hastened in so doing by the rapid penetration of heat over, and through, a very small area."

From reading what Dr. Colman said in his lecture regarding the influences temperature—through-and-through—has on the charge and the evolved gases, there is little doubt that Dr. Colman agrees with what has been proved in regard to the penetrating speed of the heat through the charge.

Dr. Bueb, from careful investigation, told us the temperature entering his setting was 1400° C. [Herr Körting's Mariendorf settings gave 1465° C.] Yet with such a high temperature, Dr. Bueb stated in regard to the travel of the gas, "The exit passage is a relatively cold core of coal." And that this was so—and probably remains so yet—is borne out by the temperatures Dr. Bueb gave of the gases evolved and the temperature of the core running together, hour by hour, as the process of carbonization goes on.

These temperatures given by Dr. Bueb will be found to compare favourably with those published from Exeter, and, by long practical experience, careful observations, and many tests (already recorded), I am satisfied the "path of the gas" is never through the coke but in that path always avoiding the annular ring of the charge already carbonized.

It is little use asserting so much without giving some proof. I will leave out altogether figures of my own, and will take a few of those published by Dr. Bueb from Dessau. Remembering that the temperature playing round the outside of the retorts working at Dessau was 1400° C., at the end of the first hour after the charge had been put in the temperature of the core of coal was only 145° C., and that of the evolved gas was 190° C.

Skipping over the recorded temperature from the first to the fifth hour, it becomes difficult to reason out that the temperature of the core of the charge was only raised to 250° C. in five hours. This being so, there surely is—and always is—less resistance to the passage of the gas through the core of the charge rather than through a hard mass of incandescent coke varying in density in proportion to its superincumbent weight.

T. SETTLE.

Dec. 12, 1910.

Relative Effects of Gas and Electric Lighting on the Purity of the Air of Rooms.

SIR,—I have been interested in the article written by Mr. G. Stanley Cooper, B.Sc., on the "Relative Effects of Gas and Electric Light on the Purity of the Air" (p. 705).

Mr. Cooper's article is devoted solely to an investigation of the percentage of carbon dioxide in the atmosphere of a room when using gas and electricity respectively for lighting. He does not appear to be aware that any similar investigation has taken place, for he opens with the words: "In this article, what to the majority of readers will be a new side to the matter is opened up;" and in concluding the article he uses the words: "A striking feature about the experiments is that there was actually less carbon dioxide in the room when gas was burning than when electric light was employed." I would refer Mr. Cooper to the address which I read before the Manchester District Institution in February, 1906, in which details were given of tests carried out at the Longwood Liberal Club. In this instance, gas and electric light were respectively employed as illuminants; and the results were even more strikingly in favour of gas.

While I make no claim to being the first to present the relative effects of gas and electricity in this form, Mr. Cooper will see that my own tests predated his by about five years; for they were taken on Dec. 12 and 13, 1905.

JNO. HY. BREARLEY.

Longwood, Dec. 12, 1910.

LEGAL INTELLIGENCE.

THE LAW AS TO FENCING EXCAVATIONS.

A point of much interest to highway authorities and contractors was raised in an appeal from a decision of Mr. Justice Ridley which came before Lords Justices Vaughan Williams, Buckley, and Kennedy last Tuesday.

The plaintiffs (appellants) were the London General Omnibus Company, and defendants were Messrs. Docwra and Son, the well-known contractors. Mr. Holman Gregory, K.C., who appeared with Mr. Gerard S. Sanders for the plaintiff Company, stated that an excavation had been made by the defendants in Upper Clapton Road, and was fenced off by a rope attached to upright iron standards. At midnight on one occasion a two-horse omnibus belonging to the plaintiffs came along; and one of the horses slipped and fell opposite to the hole. In falling it knocked down the other horse, and both tumbled into the trench—one of them being killed. The action turned upon the question of the liability of the defendants; and in the event agreed damages of £55 were awarded. The appeal was brought on the ground of misdirection by the Judge. Counsel submitted that the words "fence and guard . . . so as to prevent accidents," contained in a Metropolitan Act, dated 1835, as applied to road excavations, meant that the device for protecting such places should be of sufficient strength to withstand such an accident as might ordinarily happen. In answer to Lord Justice Vaughan Williams, Counsel said he did not contend that the fence was to be such that it was absolutely impossible for a horse to fall into the hole, but that it should be reasonably strong. Lord Justice Kennedy put it to Counsel that, supposing a jury found that a person using the road carefully was sufficiently prevented by the notice from tumbling into a hole, he could not go further. Mr. Gregory said it was not a question of notice. His contention was that one had to anticipate an accident similar to that in question, and provide reasonable protection. Lord Justice Buckley: Then your contention practically comes to this, that one ought to build a wall. Is it not the fact that in all these cases you must do the best you can? A horse might rear. Would you say there should be such a fence that it could not get its legs over? Mr. Gregory: No; you would not anticipate that. Lord Justice Buckley: But it might happen. Mr. Gregory: As a rule, that is vice in a horse; and you do not anticipate a vicious horse going through the streets. Without calling upon Mr. J. R. Randolph to argue for the respondents, the Court dismissed the appeal, holding that there had been no misdirection.

GAS AND WATER COMPANIES IN LIQUIDATION.

Mid-Oxfordshire Gaslight and Coke Company.

In the Chancery Division of the High Court of Justice last Friday, before Mr. Justice Neville, Mr. Bovill moved for the appointment of the Liquidator of the above-named Company as Receiver and Manager of a particular business in respect of which the Company had issued first mortgage debentures. Counsel reminded his Lordship that the Company carried on business all over Oxfordshire, and from time to time bought up small gas undertakings, in respect of which they issued debentures creating a first charge on the particular undertaking, and a second charge over the general assets of the Company. Several orders had been made with respect to similar first charges. His Lordship remarked that it was sometimes inconvenient to have the same person acting as Liquidator and as Receiver for the debenture-holders, because there might be a clashing of interests. Mr. Bovill said in this case no difficulty could arise, because the Company was hopelessly insolvent; the debentures being far in excess of anything that could be realized. Mr. Galbraith appeared for the Trustee of the debenture deed, and consented. His Lordship made the order as asked. Mr. Bovill said there was a second action against the Company under like circumstances, but by another plaintiff, on a different set of debentures creating a specific charge on another property, on which he should ask for a similar order.

East Coast Water Company.

In the Chancery Division of the High Court of Justice last Friday, Mr. Justice Warrington was asked to appoint a Receiver and Manager of the above-named Company at the instance of the debenture-holders. Mr. Galbraith said the applicant was the holder of £475 worth of debentures out of a total issue of £6000. The Company did not object to the application. His Lordship made the appointment; limiting it to the 31st of March next.

NATURAL GAS SUPPLY IN CANADA.

The Judicial Committee of the Privy Council, consisting of Lords Macnaghten, Atkinson, Shaw, and Robson, last week gave judgment in two appeals from Canada raising a question in regard to the supply of natural gas. The arguments were heard in July.

Some time in 1889, subterannean gas was discovered in Welland County, Ontario; and it became in large demand both as an illuminant and as fuel. Persons desiring to have the gas obtained from the owners of the land licences or leases to drill for it, and then utilized it. In 1890 and 1891, the respondents, Messrs. Carroll, obtained a

large number of these gas leases for use in their business as limestone and sand quarry proprietors; and they successfully drilled wells from which they obtained the natural gas as fuel. In April 6, 1891, they sold their leases and wells to the Erie County Natural Gas and Fuel Company, but with the stipulation that they (the lessors) should be supplied with gas enough for their own purposes. Between 1891 and 1894 the arrangement worked satisfactorily; but in the latter year the Erie Company transferred their rights to the Provincial Natural Gas and Fuel Company, Limited, who then declined to supply Messrs. Carroll with the gas, as their predecessors had done. Messrs. Carroll thereupon brought an action against the Companies and claimed substantial damages. The Canadian Courts decided in their favour. Meanwhile, Messrs. Carroll acquired other wells in order to obtain elsewhere the gas of which they had been deprived; the cost of doing so being about $60,000. The Master of the Supreme Court, to whom the question of damages was referred, assessed them at $113,965; but these were reduced by the Courts to $54,031. From this latter decision both parties appealed.

In delivering their Lordships' judgment, Lord Atkinson pointed out that as the wells and apparatus, which had cost Messrs. Carroll $60,000, were subsequently sold by them for $75,000, they would, if they were awarded the $113,965, as proposed by the Master, make a profit of upwards of $120,000 for being deprived of their gas; and this would be a grotesque result. Their Lordships could not permit them to recover more than they had lost. They had sued for the damages occasioned by the temporary deprivation of the gas. They had obtained the substituted article, identical in description and quality; had used it; and had failed to show that it had not, in the result, been obtained by them free of cost. They were, therefore, entitled to merely nominal damages. Their Lordships thought the Companies' appeal to this extent should be allowed, with costs, and Messrs. Carroll's cross-appeal dismissed, with costs.

THE AFFAIRS OF MR. E. O. PRESTON.

At the London Bankruptcy Court last Wednesday, a meeting of the creditors of Mr. Edward Oxenford Preston, financier, carrying on business at 4, Tokenhouse Yard, E.C., was held under the presidency of Mr. E. S. Grey, the Official Receiver. According to a memorandum issued by him to the creditors, it was called for the purpose of appointing a Trustee in place of Mr. Owen Walker, who had resigned. Mr. Barnes appeared for the debtor; Mr. Jarvis for several of the large creditors; and some of the others were represented.

The Chairman read a letter he had received from Mr. Walker, in which he explained that opposition had been raised to his holding the trusteeship on the ground of his being interested in some of the companies originally promoted by the debtor; and though this would not, he said, in any way affect the carrying out of his duty, he should not care to act in any case in which a creditor might think his interests would not be properly safeguarded.

Proofs of debt were then proceeded with. The debtor had filed a statement of affairs showing liabilities amounting to £58,871, of which £24,041 were returned as unsecured, £19,840 as fully secured, and £6852 as partly secured. The securities held were estimated at £6050, of which £352 were returned as due on bills (none of which were expected to rank), £4640 as contingent, of which £660 were expected to rank, and £67 as preferential—altogether a total of £28,503 to rank against the estate for dividend. The assets were returned at a net sum of £2970—bad and doubtful debts £22,125, upon which the debtor placed no value, thus disclosing a deficiency of £25,533.

The first proof to which Mr. Jarvis took objection was one lodged by the Brockenhurst Gas Company, who claimed to be creditors for £388. The representative of the Company produced a guarantee in support of the proof; but it was contended by Mr. Jarvis that it was void for want of consideration. The Chairman, however, decided to admit the proof for voting purposes.

A claim which led to some discussion was one lodged by Messrs. Spencer, Whately, and Co., Limited, whose proof amounted to £1726 in respect of goods sold and delivered to the debtor, and for which he had promised to pay, including goods sold to the Mid-Oxfordshire Gas Company. This proof was objected to by the debtor. The Secretary of the Company then produced certain evidence in support of the proof, including acceptances on which he maintained the debtor was liable. Eventually the claim was admitted by the Chairman to the extent of £178 14s. 2d.

A proof amounting to £18,000 of the Ticehurst and District Water and Gas Company, for whom Mr. Jarvis was appearing, was strongly objected to by Mr. Barnes. It appeared that the proof was in respect of damages for alleged fraud and misfeasance arising from the sale by the debtor to the Company of certain gas-works. In support of the proof, Mr. Jarvis said he could produce the statement of claim. The Chairman remarked that he was not going to try the action, and he should not admit the proof for anything unless there was a specified amount that had been paid by the Company. Mr. Jarvis said there was one item of £822 which had been paid by them instead of by the debtor. This had been admitted in the pleadings; and he submitted that the proof should be allowed for this amount. He had not anticipated that the claim in respect of the alleged fraud would be allowed; but he considered that when a man bought gas-works for something like £300 and sold them to a Company for £16,000 there must be a discrepancy somewhere. The Chairman said it was only the usual discrepancy in this class of case. He added that he did not see how he could dissociate different parts of the statement of claim; and, under the circumstances, he thought it his duty to admit the proof for absolutely nothing.

After the proofs were all dealt with, the Chairman said he thought

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the meeting should first of all pass a resolution for a Trustee to be appointed in place of Mr. Walker, notwithstanding the fact that this gentleman had in reality tendered his resignation. A resolution for the removal of Mr. Walker was then carried *nem. dis.*, it being remarked by a creditor that he should like it to be understood that it was only a tacit resolution. Subsequently, the names of Mr. E. H. Hawkins and Mr. F. S. Salaman were submitted; and on a vote being taken, the former gentleman was appointed.

The Chairman said he did not consider it necessary to appoint another Committee of Inspection; and the meeting then closed.

Income Tax Allowance for Depreciation.

An appeal on behalf of the Montrose Gaslight Company for an allowance in respect of depreciation by way of decreased value of plant and machinery by reason of wear and tear, was recently heard before the General Commissioners at Montrose. Mr. D. Smith, who appeared on behalf of the Company, explained to the Commissioners that they had always been allowed depreciation in past years, but that in the autumn of 1909 the Inland Revenue authorities issued a circular stating that "no depreciation should be allowed." After dealing with the Acts of Parliament, Mr. Smith contended that the Company had sufficient to do in fulfilling the legislation of the Government, without submitting to regulations framed by Government officials. Several appeals heard in England, Ireland, and Scotland were quoted for the guidance of the Commissioners. After hearing arguments, the Commissioners decided that they had no option but to allow depreciation in accordance with the Customs and Inland Revenue Act, 1878, and the Finance Act, 1907; and they decided accordingly.

Dangers of Street Boxes.

In the King's Bench Division of the High Court of Justice last Thursday, before Mr. Justice Grantham and a Special Jury, Mrs. Louisa Elizabeth Elliott, wife of a music instructor in the Army, recovered damages against the Battersea Borough Council for personal injuries sustained by her. Her case was that on Oct. 29, 1909, she was standing at the corner of Latchmere Road and Battersea Park Road, and was resting her hand upon an iron box fixed in the pavement while she watched smoke issuing from the roadway. The Fire Brigade were coming along the road. Suddenly the box on which she had placed her hand was blown open, and her clothes, hands, and face were burnt. It was subsequently found that she had sustained serious internal injuries, likely to be of a permanent character. The defendants denied negligence, and said the accident was incidental to the use of electricity. It was due to a London County Council workman, who, while engaged on tramway work, injured the casing of an electric light cable and let in the damp. The Jury awarded the plaintiff £525 damages, and judgment was entered for this amount, with costs—a stay of execution being refused.

MISCELLANEOUS NEWS.

PREPAYMENT METER CHARGES IN MANCHESTER.

Gas Committee Recommend no Further Concession.

A Special Meeting of the Gas Committee of the Manchester Corporation was held last Thursday to consider a further proposal by certain members of the Council, led by Mr. Jennison, that the price of gas to prepayment consumers should be reduced. At present the Corporation supply 30 cubic feet for 1d. by automatic meter, which works out at 6d. per 1000 cubic feet more than is paid by ordinary consumers. It is argued in support of a reduction being made that it is unjust to charge so much more to users of prepayment meters, especially as they are chiefly poor people; Mr. Jennison's aim is that the price shall be the same to both classes of consumers.

A return was presented showing that, taking 44 corporations in the United Kingdom, the average quantity of gas sold for 1d. through slot-meters was 28 cubic feet, and that the average of 55 gas companies was 25 cubic feet, compared with 30 cubic feet in Manchester. It was also demonstrated that the cost of distribution, management, repairs, renewals, interest charges, &c., was 5·2d. per 1000 cubic feet in the case of ordinary consumers, and 13·2d in the case of prepayment meter consumers. Though the additional cost to the Gas Department in the case of the latter class of consumers is upwards of 7d. per 1000 cubic feet, they are only charged 6d. more than the ordinary consumers, who get their gas at 2s. 3d. per 1000 feet.

The matter was discussed at considerable length; and in the end it was decided that the Committee could not recommend the Council to make any change at present in the charge for gas to users of prepayment meters; the feeling of the Committee being that while they are expected to make so large a yearly contribution in relief of rates as they now do, they cannot possibly grant any further concessions to the gas consumers.

In the course of an interview after the meeting, Alderman Gibson, the Chairman of the Gas Committee, said there had been no complaints from the consumers, and there were numerous applications coming in for the fixing of prepayment meters. Manchester, he added, did what other towns did not. Not only did they give £50,000 a year to the rates, but supplied and fixed cooking stoves, &c., free of charge.

Some time ago, Alderman Gibson furnished Mr. Jennison with all the information available on this subject, and showed how impossible it was for the Committee to grant this gentleman's request to place slot-meter users on the same footing as ordinary consumers. By way of illustration, he pointed out that it would cost a grocer more to sell 16 separate ounces of tea than a single pound to one consumer; that the ordinary consumer burnt 40,000 cubic feet per annum against the prepayment consumer's 9000 cubic feet; that it would cost £1500 to alter

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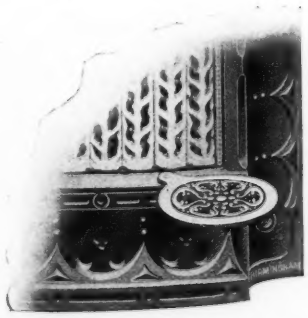

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the indices of 60,000 meters; and that Mr. Jennison's proposal would mean a loss to the Gas Committee of £15,000 a year in revenue.

A notice of motion on the subject by Mr. Jennison is included in the *agenda* for the next meeting of the City Council; it not having been reached when they adjourned at the last sitting. This will be the fourth time Mr. Jennison has brought the question forward.

Some idea of the magnitude of the business done in this section of the Gas Department may be gathered from the fact that at the end of last quarter there were more than 61,000 slot meters in use within and outside the city boundaries. In round figures the year through, they yield, on an average, upwards of £1500 weekly. Besides the 48 collectors engaged day by day in the work of collection from the meters, there are 15 others known as "broken-period men," whose duty it is to visit houses where tenants are about to remove, and clear the meters of their contents.

POISONED BY COAL GAS.

A Singular Case in Lancashire.

After an inquiry extending over two-and-a-half hours, a Coroner's Jury at Leigh (Lancashire) returned a verdict of "Death from inhaling coal-gas fumes" in the case of Daniel Holt, an engineer employed at the silk mill of Messrs. S. Courtald and Sons, Leigh.

It was stated that on Saturday, Dec. 3, eight men from the Selas Gas Lighting Company commenced work at the mill for the putting down of a high-pressure gas plant (which, of course, involved a changing of the gas brackets and pendants throughout the factory); Holt being on duty on that day and the Sunday. When Holt reached home on the Sunday, he complained to his wife about having been "gassed" when passing through the shed—saying he felt dizzy and sick. He continued work on the Monday, although evidently ill; and on the Tuesday morning was taken home, dying four days later. Henry Wyatt, who occasionally took charge of the engines for Holt, said that the deceased complained to him about there being "that old smell of gas again" in the shed on the Sunday. Witness also smelt it. He heard that when the gas was turned on, the pipes were open. They called it "blowing the gas through." Dr. A. T. Ross, who had made a post-mortem examination of the body in the presence of Drs. Craven Moore, J. Jones, and Auden, said the body was well-developed and well-nourished. Rigor mortis was well-marked in the legs, arms, and jaws. The blood appeared unusually red, which was consistent with poisoning by carbonic oxide; and he was of opinion that death was due to this. The evidence was also consistent with a man dying from the result of coal-gas poisoning. In answer to a juryman, the Doctor said it was possible for two men to go where there was gas and one to escape its effects and the other to be affected. Witness's evidence was put in writing and signed by the three other medical men who took part in the post-mortem examination.

VENTILATION OF STREET-BOXES.

At the Meeting of the London County Council last Tuesday, the Highways Committee reported the receipt of a letter from the Woolwich Borough Council, asking the County Council to consider the advisability of framing regulations applying to the County of London, and enforceable by local authorities, to secure the ventilation of street boxes constructed by the Post Office, and by telephone and electric lighting bodies. The Borough Council stated that explosions had taken place owing to the escape of gas into the receptacles in question, and that in their opinion all such boxes should be ventilated, in order to prevent the possibility of explosion. The matter arose out of the application to the Borough Council by the Postmaster-General for sanction to lay an underground telegraph line in Woolwich, and the imposition by the Council of a condition of their assent that the inspection box in connection with the system should be efficiently ventilated. This condition was objected to by the Post Office authorities, and was withdrawn by the Borough Council subject to reserving their right to raise again the question of principle. The Woolwich Council stated that they had communicated with the other Metropolitan Borough Councils on the subject, and thirteen of them had made representations in support of the proposal. The Highways Committee pointed out that it was usual, in regard to works approved by the Council, to require that adequate means should be taken to prevent the accumulation of gas in boxes and conduits; but this condition did not apply to works carried out by local authorities having electric lighting undertakings, with the exception of the St. Pancras Borough Council. With regard to street boxes for telephone and telegraph wires, the Committee were advised that the Council had no general authority to frame the regulations suggested; and they recommended that it was undesirable to seek for parliamentary powers to enable such regulations to be made. This recommendation was adopted; and the Woolwich and other Borough Councils will be informed accordingly.

ELECTRICITY SUPPLY TO SMALL HOUSES.

A Proposal at Oldham.

The Electricity Committee of the Oldham Corporation recently had their attention called by the Electricity Engineer (Mr. S. W. Newington) to the scheme introduced at Eccles for supplying electricity to small houses at 6d. per week, to which reference has already been made in the "JOURNAL." He said current was supplied to a row of houses through a bulk meter, each house having half-a-dozen lights. As a matter of fact, there was nothing in the thing. He had 24 lights at his house, and his electricity bill worked out at less than 1s. per week. His neighbour had the same number of lights, and his bill was even less. It was all a question of economy in using. Electricity did not

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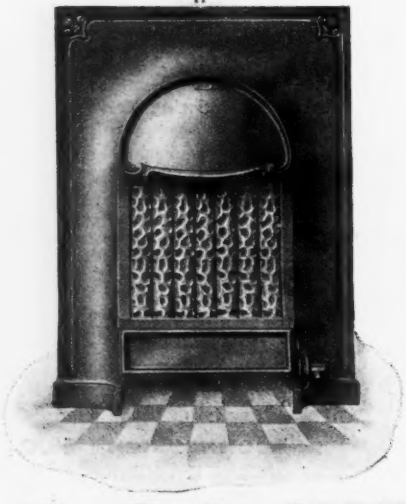

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cost more than gas in small houses if it was used carefully. The present prices at Oldham were quite as low as those quoted at Eccles. If people used electricity carefully, with metallic filament lamps, it was as cheap as any other illuminant. The people had to buy their own lamps; and the longer they had the lights on, the oftener would these require renewing. The greatest difficulty in regard to the cost was with the meters, which were on hire. His idea was to carry out the whole scheme at so much per light per annum.

METROPOLITAN WATER BOARD.

The Board as Ratepayers—Examination of River Water.

At the Meeting of the Metropolitan Water Board last Friday, the Appeal and Assessment Committee reported that, for the purposes of the current quinquennial valuation in the Metropolis, the revised rateable value of the Board's property, finally approved, amounted to £636,692. The principal valuations were: City of London, £44,518; Westminster, £59,801; Camberwell, £38,989; Wandsworth, £46,807; Kensington, £35,898; Lambeth, £32,374; Islington, £34,500; Stoke Newington, £24,140; Marylebone, £25,906; Hammersmith, £27,649; St. Pancras, £21,320; and Hackney, £22,020. The Chairman of the Committee (Mr. C. E. Musgrave), in moving the adoption of the report, said he knew of no other body in the United Kingdom which was rated so highly as the Board. Last year, out of the gross water-rental (£2,759,000), they paid in rates and taxes £413,000, which was equivalent to 14·98 per cent. Of their gross revenue, 2d. out of every shilling which the Board took into their coffers for the supply of water was returned in the shape of rates. The report was adopted.

At the same meeting, the sixth report of the Director of Water Examination (Dr. A. C. Houston) on research work carried out by him, dealing with the comparative vitality of "uncultivated" and "cultivated" typhoid bacilli in artificially-infected samples of raw river water, with special reference to the question of storage, was presented. In the report, it was stated that the Director treated liquids containing myriads of typhoid bacilli with raw Thames river water. In two experiments the typhoid bacillus was dead within one week, and in two other experiments dead within two weeks. Although the Director was well satisfied with his negative results, he put the matter to the crucial test of drinking half-a-pint of the infected water (which contained initially over 218 million typhoid bacilli) on the 24th day from the start of the experiment without any evil effects. He pointed out that most persons would consider a "drinking experiment" as much more conclusive evidence of "safety" than any negative laboratory results.

The East Ham Town Council recently received quotations for the lighting by gas and electricity respectively of the workshops at the sewage works. The quotation of the Gaslight and Coke Company, at £14 6s., for lighting by gas was accepted.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

In the Glasgow Town Council on Thursday, Mr. D. M. Stevenson, in submitting the minutes of the Special Committee on Smoke Abatement, said he thought that everybody connected with the recent Smoke Abatement Exhibition had been satisfied with the result of the enterprise. The exhibitors were particularly pleased. The financial outcome was also very satisfactory; and he hoped they would adopt the suggestion which had been made and have another exhibition before long. In the minutes submitted by Mr. Stevenson, it was stated that the total number of visitors to the exhibition was 69,010, and that there was a net surplus of £1045. The Committee recommended that £200 be placed to each of the gas and electricity departments, on account of outlays incurred by them for work done prior to the opening and during the run of the exhibition, in adapting the buildings for the purpose of holding an exhibition, and otherwise; and that the balance be handed over to the Treasurer of the Police Department for behoof of the Sub-Committee on Air Purification, on the understanding that it be employed in furthering the objects which the Special Committee had in view in organizing the exhibition. The Committee recorded their appreciation of the services rendered by the officials of the various Corporation departments connected with the exhibition, and also of the Manager and Secretary. They were satisfied that the results had justified the carrying out of the scheme, and that it would prove to have been of great advantage to the city generally in the promotion of smoke abatement.

The following statement was published in the "Glasgow Herald" on Wednesday: "A motion to be introduced at to-morrow's meeting of the Corporation touches one aspect of municipal overlapping which is not only wasteful, but which puts ratepayers to avoidable inconvenience. There are separate staffs for the inspection of gas, electricity, and water meters; and these officials call at different times. It would be a simple matter to arrange identical periods, to which accounts apply, in the three departments, so that one visit each term, by one inspector (instead of by two or three), would be sufficient. This would effect a substantial economy, and be on the lines of municipal unification, which is essential to any real administrative reform." The motion referred to does not appear to have been made, or, if made, it would seem to have received scant courtesy.

In the Hamilton Town Council on Tuesday, the Gas Committee reported that the coal carbonized in the half year to Nov. 30 last showed a decrease of 133 tons, and that there had been an increase of 1,259,600 cubic feet in the make of gas, and a decrease of £246 in wages. The Manager—Mr. J. Ballantyne—reported that all the contracts for the new coal-handling plant had been completed, and that everything was working satisfactorily.

The Dunfermline Town Council had before them on Monday a

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The BLAND NEW TYPE BURNERS.

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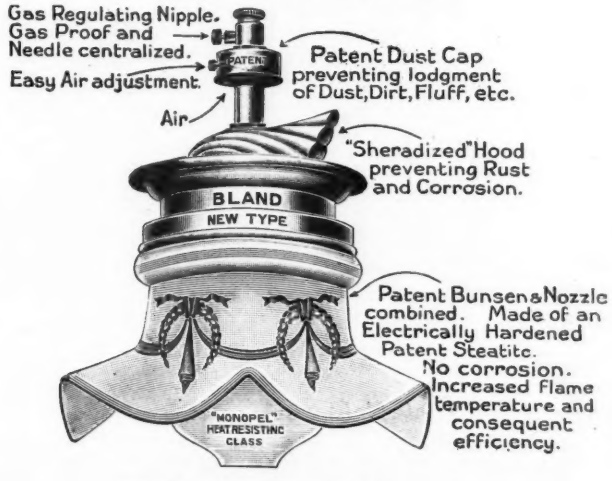
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Patent Dust Cap preventing lodgment of Dust, Dirt, Fluff, etc.
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NEW TYPE
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The Bland Light Syndicate, Limited, will be most happy to send to any Gas Company, free of all charge, as much advertising literature, Gas *v.* Electricity, &c., as required.

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minute by the Gas Committee to the effect that the Convener—Mr. T. Stewart—had brought before the Committee the advisability of giving a demonstration, at or near the City Chambers, of the lighting capabilities of gas on the high-pressure system, and that the Committee had agreed to the proposal—the Lighting Committee to furnish four lamps of a sufficient candle power for the purpose, and the Gas Committee to supply the necessary compressor. The Lighting Committee's minute stated that they had agreed to fit up four lamps of 1500-candle power each, at an estimated cost of £24. Only one dissentient voice was raised to the proposal, and it was consequently adopted.

The Inverurie Town Council on Monday, on the motion of Treasurer Rae, resolved to enter into negotiations with the Gas Company regarding a transfer of the gas undertaking; and the whole Council were appointed a Committee to approach the Company on the subject.

A correspondent writing in the "Aberdeen Daily Journal" of Tuesday last, in denunciation of the proposal to obtain parliamentary powers for the sale by the corporations of electrical lamps and fittings, states that the movement is the outcome of an agitation on the part of a few municipal engineers and councillors in various parts of the country. Owing, it is said, to gas competition, the profits on electrical fittings are already cut very fine indeed, and the prospect of still further competition on the part of municipal retail trading departments, backed by the rates, is received with great apprehension.

Lecturing in the Glasgow University on the evening of Monday of this week upon "Thorium: Its History, Uses, and Radio-Activity," Mr. Frederick Soddy, M.A., F.R.S., gave an account of the properties of thorium, and of its application in incandescent gas lighting, and added interesting statistics supplied by Mr. S. B. Langlands, the Inspector of Lighting in Glasgow, with regard to the use of gas-mantles in the lighting of the streets of the city. The number of mantles used per annum in Glasgow was 200,000, giving light sufficient to illumine the road from London to Glasgow. About 9½ mantles were employed per lamp in the Glasgow streets every year; and the quantity of gas consumed per mantle averaged 1000 cubic feet. About 1 cwt. of ash was recovered each year from the mantles used in the lighting of the city streets, and was returned to the manufacturers to be utilized in the making of new mantles.

Prepayment Gas-Meters Used as Savings Banks.—Presiding at the annual meeting of the Manchester and Salford Savings Bank last Wednesday, the Bishop of Manchester (Dr. Arbuthnot Knox), referring to the action of the Committee in issuing home safes, said he had been told on good authority that the penny-in-slot gas-meters were largely used for saving money, and that when the Corporation inspectors went round to collect they had to release not only the pennies deposited for payment of gas consumed, but florins, half-crowns, shillings, and even half-sovereigns, which had been put there for safe keeping. This, added the Bishop, proved the value of home safes, of which the bank had 3659 in use.

CURRENT SALES OF GAS PRODUCTS.

[For Table of "Tar Products Prices," see p. 872.]

LIVERPOOL, *Dec.* 17.

Sulphate of Ammonia.

During the past week the market has been very quiet, with a tendency towards still lower prices. This is no doubt to be attributed to the fact of dealers having covered the bulk of their requirements for this month in good time, so as to effect shipment before the Christmas holidays. At the close, the values are £12 10s. to £12 11s. 3d. per ton f.o.b. Hull, £12 11s. 3d. to £12 12s. 6d. per ton f.o.b. Liverpool, and £12 12s. 6d. to £12 13s. 9d. per ton f.o.b. Leith. In the forward position, no new business has been recorded by manufacturers, who maintain a firm attitude; but it is reported that second-hand sellers are offering abroad at the equivalent of £12 10s. per ton f.o.b. British ports for delivery next year.

Nitrate of Soda.

There is again no change in the situation of this article, and the spot quotations continue to be given as 9s. 4½d. per cwt. for ordinary, and 9s. 7½d. for refined quality.

LONDON, *Dec.* 19.

Tar Products.

The markets for tar products have remained fairly steady throughout the past week, and the inquiry for pitch has been better; in many quarters improved prices having been paid for January-June delivery. Benzols remain in about the same position. Creosote is quiet, and new orders are difficult to negotiate. Crude carbolic makers are still firm in their ideas of price; but not many contracts are reported at the present high prices. Solvent naphtha continues quiet; and heavy naphthas are fairly firm.

The average values during the week were: Tar, 17s. to 20s. 9d. *ex* works. Pitch, London, 34s. 6d. to 35s.; east coast, 33s. to 34s.; west coast, Clyde ports, 33s. 6d. to 34s. 6d., Manchester, 32s. 6d. to 33s. 6d., Liverpool, 33s. to 34s. Benzol, 90 per cent., casks included, London, 8d. to 8½d.; North, 7¾d. to 7½d.; 50-90 per cent., casks included, London, 8d. to 8½d.; North, 7¾d. to 8d. Toluol, casks included, London, 9d. to 9½d.; North, 9d. Crude naphtha, in bulk, London, 3⅜d. to 4¼d.; North, 3⅛d. to 3¼d.; solvent naphtha, casks included, London, 11½d. to 1s.; North, 10½d. to 11d.; heavy naphtha, casks included, London, 11⅜d. to 1s.; North, 11d. to 1s. Creosote, in bulk, London, 2⅜d. to 2½d.; North, 1⅞d. to 2d. Heavy oils, in bulk, 2¾d. to 2¾d. Carbolic acid, 60 per cent., casks included, east coast, 1s. 1½d.; west coast, 1s. 1d. Naphthalene, £4 10s. to £8 10s.; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

The inquiry for prompt delivery has been better, and prices on the whole are steady. Beckton are quoting only for spring delivery.

THE "DARWEN" ARCH PIPE

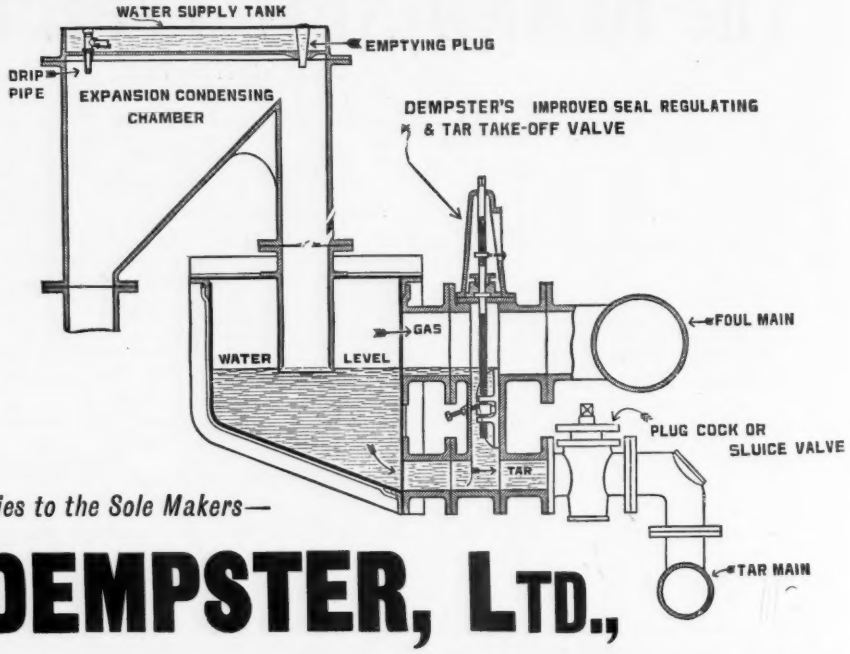
Prevents Stopped Ascension Pipes.

"The Cost is moderate and can be saved in a Single Season."

"The Arch Pipes can be seen in operation upon application."

"It will pay you to try them upon troublesome Pipes."

Upwards of 400 are already at Work or on Order.



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GAS PLANT WORKS, **MANCHESTER.**

COAL TRADE REPORTS.

Northern Coal Trade.

There is a stronger demand for coal, as is often seen before the holidays, and prices show some steadiness. In the steam coal trade, best Northumbrians are from 9s. 10½d to 10s. per ton for early delivery. Second-class steams are steady at from 8s. 6d. to 8s. 9d., and steam smalls are about 4s. 10d. to 6s. 3d.—steam coals being somewhat scarce for delivery before the holidays. In the gas coal trade, the heavy deliveries continue; the time of the heaviest consumption being now just at hand. Durham gas coals are quoted from 8s. 3d. to 9s. 3d. per ton f.o.b. for the usual classes; while for "Wear" specials, about 10s. 6d. is the figure. The contracts for the London supplies previously referred to are now practically settled. There are also a few smaller contracts settled at prices that are, for next year, slightly below those that now rule. At the same time, the tendency is towards the belief that there will be rather higher prices quoted now that the large contracts have been fixed, and a part of the output thus taken up. Gas coke is in better demand, at about 14s. 6d. to 14s. 9d. per ton f.o.b.

Scotch Coal Trade.

Trade has become quieter for home demands. Foreign orders for ell and splint have been more plentiful; and there have been welcome inquiries by foreign buyers for forward delivery. The prices now quoted are: Ell, 9s. to 10s. per ton f.o.b. Glasgow; splint, 9s. 9d. to 10s.; and steam, 9s. to 9s. 3d. The shipments for the week amounted to 315,553 tons—a decrease of 9287 tons upon the previous week, but an increase of 30,566 tons upon the corresponding week last year. For the year to date, the total shipments have been 15,289,738 tons—an increase upon the corresponding period of 750,371 tons.

Reduction in Price at Brighton.—The price of gas is to be reduced 1d. per 1000 cubic feet by the Brighton and Hove Gas Company as from the end of the current quarter.

Financial Position of Colwyn Bay.—The report of Mr. William Griffith, the Local Government Board Auditor, on the accounts of the Colwyn Bay Urban District Council for the year to March 31, has been submitted to the Council. It shows that there was, at the end of the twelve months, a net overdraft at the bank of £16,722, and that the overdraft on revenue account had increased from £10,044 at March 31, 1909, to £11,452. Mr. Griffith says he is glad to learn that the Council have decided to increase the general rate; and he expresses the hope that they will make further provision for the extinction of the overdraft within a reasonable period. He disallows £600 paid in interest on the money borrowed from the bank. Mr. G. Bevan, the Chairman of the Finance Committee, said that the financial position of the town was, for the time being, serious; and it would take £1366 a year for five years to wipe out the deficiency.

Electric Light Failure at Middlesbrough.

Middlesbrough was particularly unfortunate on the evening of last Saturday week, as, owing to a failure of the electric current, the tradesmen suffered considerable inconvenience. Not only was this the case, but the music lovers in the town and neighbourhood were deprived of the pleasure of hearing an organ recital at the Town Hall, in which about 1500 people were assembled, in consequence of the absence of power—presumably for working the bellows. At a quarter to nine (an hour after the recital should have commenced) it was announced that the performance would be given the next afternoon. The Electricity Engineer (Mr. H. M. Taylor) was informed of the failure about half-past seven, and at once set to work to locate and repair the fault; and by a quarter to ten the full supply of current was available. Unfortunately, those who wished to hear the organ recital were doomed to further disappointment; for, when they assembled at the Town Hall on Sunday afternoon, a notice informed them that the blowing apparatus of the organ was out of order, and could not be repaired in time.

Coggeshall New Water-Works.—The new water-works at Coggeshall, the construction of which has been in hand rather more than a year, are now nearing completion. The well which has been sunk is 59 feet deep and 7 feet in diameter. It is lined with cast-steel cylinders. The pumping-station is built of red-brick, with iron casements and tiled roof, and contains gas-producing plant which drives two 12-H.P. gas-engines, working a double set of three-throw pumps, with a lifting capacity of 8000 gallons per hour, which can be increased, if required, to 12,000 gallons. At a recent trial, the engine plant worked without a hitch. The reservoir has a capacity of 163,000 gallons. After leaving it, the water passes through a 7-inch main into Coggeshall, and thence into smaller pipes, the total length of which is nine miles.

Sowerby Bridge Gas Manager's Salary Advanced.—When a recommendation of the Gas Committee, that the salary of their Manager (Mr. A. W. Bissell) be increased by £40 per annum, came up for confirmation by the Sowerby Bridge Urban District Council, Mr. Whiteley explained that the Committee had decided on this step after fully considering the matter, and taking into account the fact that Mr. Bissell had a good chance of securing another position. They felt it would be very unwise to change their Engineer at the present time, not only because of the extensions at the gas-works, but also because Mr. Bissell, having been in the neighbourhood for such a long period, had acquired a knowledge of the works, and the district, which it would take a long time for another gas engineer to obtain. At present they supplied gas to a population of something like 30,000 people, and their gas area extended from Brearley to Starne Mill on the one hand, and from Midgley to Barkisland on the other. Though the advance proposed was no doubt a good one, he thought no one who remembered Mr. Bissell's services since he came among them would say the action of the Gas Committee was not justified. The recommendation was agreed to.

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LEST YE FORGET.

A Social Gathering at Greenwich.

An annual event which is always looked forward to with much pleasure took place at the West Greenwich Gas-Works Institute last Saturday evening, when a party of some 150 sat down to dinner, under the chairmanship of Mr. J. F. Braidwood, the Engineer of the station, and President of the Institute, which is managed by a Committee, of whom Mr. Alfred Showell is the Hon. Secretary, and Mr. H. P. Hollis Assistant Hon. Secretary. In addition to the employees at this particular works who had not to be on duty, the gathering included a number of visitors from other stations of the South Metropolitan Gas Company. Mr. W. Doig Gibb, the Chief Engineer of the Company, and Mr. F. M'Leod, the Secretary, expressed their regret at being unable to attend. Those present included Mr. J. D. C. Hunter and Mr. J. Newbold, Employee Directors, Mr. P. Richbell, Chief Cashier, Mr. H. Day, Chief of the Automatic Department, Mr. C. T. Drumgold, the Chief Storekeeper, Mr. M. E. Nicholls, the Chief Indoor Inspector, Mr. H. Austin, who has lately retired from the position of Employee Director, and some half-dozen old pensioners. After dinner, a large number of prizes were distributed to successful competitors at the summer flower show, and in connection with various games, &c.; and there was also a little appropriate speech making. These items were interspersed with music and song. The room was gaily decorated with flags; and on the walls two prominent objects caught the eye. The first was an excellent portrait in oils of the late Sir George Livesey, the cost of which was defrayed by a subscription among the men; and the other, the "Good Samaritan" St. John Ambulance trophy presented by the late Chairman some years ago for competition among the different stations of the Company, and which now for the first time is held by West Greenwich. The Chairman proposed "Prosperity and welfare in every form and shape to the South Metropolitan Gas Company," coupling with it the names of the Chairman, Directors, and two chief officers. He remarked that, but for the many kindnesses and privileges accorded to them, those serving the Company would not be in the happy position that so many of them occupied now. They owed it all really, in starting, to Sir George Livesey; and Mr. Carpenter was, he believed, following very closely in his footsteps. There was no doubt that, if each one put his shoulder to the wheel, co-partnership had come to stay. Mr. Hunter and Mr. Newbold replied. The toast of "The Chairman" was submitted by Mr. Austin, who remarked that he had heard Mr. Braidwood speak highly of those he had charge of. In reply, the Chairman said he was always pleased to help in anything going forward, and to do what he could for the men. In addition to the prizes and St. John Ambulance certificates which were awarded, several presentations took place during the evening. In acknowledgment of his services as Librarian to the Institute for the past fifteen years, Mr. Harry Colebrook was handed a silver cigarette case; while Mr. Showell, for his work as Hon. Secretary to the Sick Fund, was given a handsome case of cutlery. Last, but not least, the Chairman presented to each of the six members of the West Greenwich Gas-Works St. John Ambulance class, who had been successful in bringing the challenge trophy to this station, a photographic group of themselves surrounding the trophy. He remarked that their success was highly creditable to them, as West Greenwich was only a small station, and therefore there were not many men to choose from for the competition.

Exmouth Water-Works Extensions.—It is proposed to begin early next year the construction of the Dolton water scheme for the Exmouth District Council. The scheme includes the construction at Dolton of a pumping station, comprising air-lift plant and a tank for the reception of the water. Five miles of 12-inch and 9-inch mains will be laid from Dolton to the existing reservoir at Squabmoor; and the water will be forced to this level by three-throw ram-pumps. The motive power will be provided by gas-engines and a suction gas-plant.

Extensions at the New Mills Gas-Works.—The Clerk to the New Mills Urban District Council (Mr. J. Pollitt) has received notification from the Local Government Board that the Council's application to borrow £3400 for gas-works purposes had been sanctioned. Part of the amount is for an extension of the water-gas plant, which is urgently needed to meet the requirements of the district. Since the Council acquired the gas undertaking, the works have practically been rebuilt; and the price of gas has been reduced nearly one-half.

Royal Engineers at the Taunton Water-Works.—Through the courtesy of Alderman J. G. Vile, the Chairman of the Water Committee of the Taunton Corporation, a party of officers of the Royal Engineers, from Chatham, recently inspected the water-works, which are situated among the Blackdown Hills. Information was given to the visitors by Mr. H. T. Coles, the Manager of the works; and the party were very much interested in the undertaking. The three reservoirs—Luxhay, Leigh, and Blagdon—were quite full; the storage amounting to about 160 million gallons. The Luxhay reservoir, which was opened in 1905, has a water area of 18 acres, a depth of 57 feet, and a capacity of 120 million gallons. On the return journey, a call was made at the filter-beds.

Suicide by Gas in Birmingham.—An inquiry was held in Birmingham last Friday into the circumstances attending the death of Thomas Henry Carter (42), an art metal worker. Deceased had had family trouble and had given way to drink. The door of his house was found locked one day, and on entry being made through the window he was discovered in a moribund condition upon a bed. He was removed to the Infirmary, where he died last Tuesday. The police-constable who entered the premises said there was a faint odour of gas, and he noticed that a piece of tubing had been affixed to the gas-pipe; the other end lying on the bed. No gas was coming from the pipe, which was supplied by a slot-meter; but from the time the deceased locked himself in until an entrance was effected, 28 cubic feet of gas had escaped from the pipe, which was turned on full in the bedroom. The medical evidence was to the effect that poisoning by coal gas had probably set up inflammation of the brain, and had caused hemorrhage. The Jury found that Carter had committed suicide; but they added that there was no evidence as to the state of his mind.

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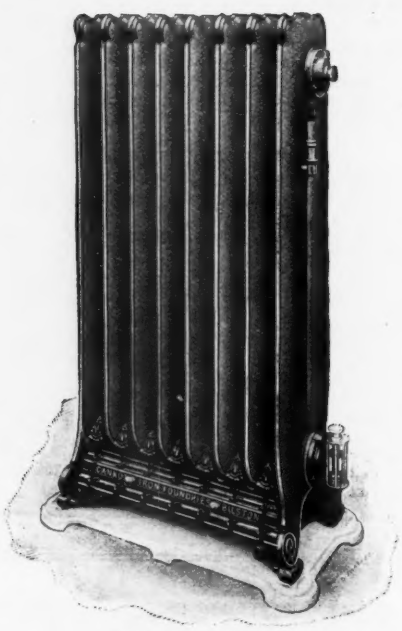

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Monte Video Gas and Water Supply.

According to the latest report for the year ended 1909 of the British Consul in Uruguay, the Monte Video Gas Company are steadily increasing their business, in spite of the keen competition of electric lighting. They have established themselves in a handsome new building, with ample window fronting, which affords full opportunity for an attractive display of goods. The price of gas, which in 1867 was 18c. (9d.) per cubic metre, has been gradually reduced to its present moderate cost of 8c. (4d.) for lighting and 6c. (3d.) for other purposes. This is equal to a reduction from 21s. to 9s. 6d. and 7s. respectively per 1000 cubic feet. With regard to the water supply, the Consul states that during the year covered by his report the Water Company expended £250,000 of new capital on extensions and improvements. These include a new powerful triple-expansion engine with two sets of pumps—one for forcing the water of the River Santa Lucia to the filter beds, and the other for pumping the purified water to the reservoirs, a distance of 21 miles, whence it gravitates for 15 miles to Monte Video. The capacity of the reservoirs is 13,125,000 gallons.

Exeter Corporation and the Standard Burner Bills.—At the last meeting of the Exeter City Council, Mr. Lucas, when moving the adoption of the report of the Parliamentary Committee, alluded to the share of costs the Council had been called upon to pay in connection with their opposition to one of the Gas Companies (Standard Burner) Bills. He stated that the amount would be £237.

Thefts from Prepayment Gas-Meters.—At the County of London Sessions, last Tuesday, before Mr. Loveland Loveland, K.C., Deputy-Chairman, Oscar Bartley and Rose Burrows were indicted for being concerned in stealing 5s. 11d., 10s. 4d., and 2s. from prepayment gas-meters, the property of the Gaslight and Coke Company, in premises in Cross Street, Islington. Evidence having been given by the occupant of a flat on the same floor as that on which the accused lived, the jury found both of them guilty. Bartley was sentenced to seven months, and Burrows to three months,' imprisonment, with hard labour.

Lighting of East Stonehouse.—The Plymouth and Stonehouse Gas Company have won a notable victory in a competition for the public lighting of the part of their district of supply which is under the control of the East Stonehouse District Council. When the time came for the renewal of the contract, the Devonport Corporation Electricity Committee made an offer to the Council of a tempting character; and as the Corporation's electricity works are in the District Council's area, it found some support among those who thought that the electricity undertaking should be supported because it contributes to the rates. It was decided that a test should be carried out; and electric light standards were erected by the Corporation in several of the main streets, so that members of the Council and others interested might see the electric light in juxtaposition with the improved incandescent burners put up by the Gas Company. As the result of this competition, the Council have agreed to renew the contract with the Gas Company for a further term of seven years. The only new condition is that the Company shall maintain a gas-testing station at the East Stonehouse Town Hall.

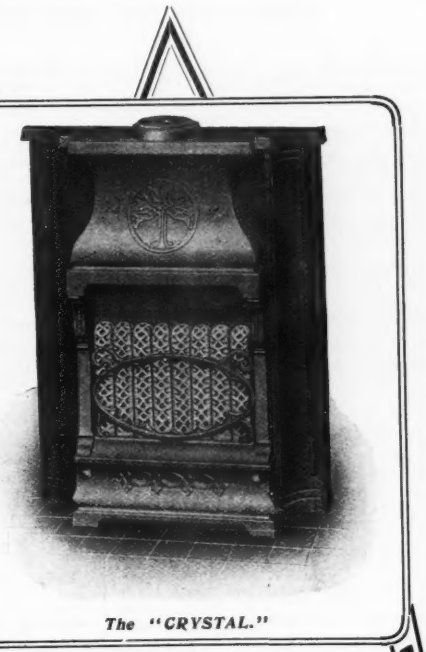
Last week, after hearing two charges of robbing automatic gas-meters, the Willesden Magistrate said that a fortune awaited the man who invented an automatic gas-meter that could not be broken open.

It is stated in the report of the Directors of the First Garden City, Limited, for the year ended Sept. 30 last that the outlay on gas and water works, electric mains, roads, and sewers during the year was £7722.

A report of the General Purposes Committee to the Dorchester Town Council stated that they had had a consultation with Mr. Steele, representing Messrs. J. & W. Purves, of Exeter, with reference to a proposed supply of electricity for the borough. The Committee recognized the desirability of having the town lighted by electricity, and recommended that no opposition be made to the obtaining of a Provisional Order. The Council adopted this recommendation.

APPLICATIONS FOR LETTERS PATENT.

28,214.—Rowland, T., "Heating or cooling water, gas, or other fluid." Dec. 5.
28,237.—Gas Economizing and Improved Light Syndicate, Limited, and Wilkie, J., "Gas-burners." Dec. 5.
28,250.—Priestman, A., and Beddoes, H., "Controlling the flow of liquids." Dec. 5.
28,296.—Greenfield, J., and Jones, A. E., "Automatically closing gas-burner supply-pipes when the gas supply fails." Dec. 6.
28,306.—Burnett, H. R., "Fittings for the lighting of streets and other spaces." Dec. 6.
28,325.—M'Lean, D. A., "Mantles and their packing." Dec. 6.
28,388.—Duckham, A. M'D., "Vertical retorts." Dec. 6.
28,420.—Wolf, L., and Akesson-Amrein, L., "Inverted burners." Dec. 6.
28,433.—Volk, M., "Incandescent burners." Dec. 7.
28,471.—Urban, A., and Hamburger, F., "Gas-igniters." Dec. 7.
28,519.—Heane, M., "Stationary piston gas-engine." Dec. 8.
28,523.—Perry, W. F., "Lighting gas-burners from a distance." Dec. 8.
28,524.—Williams, J., "Supplying carburetted air." Dec. 8.
28,528.—Owen, R. T., "Mantles." Dec. 8.
28,542.—Mitton, T. J. L., "Self-sealing lids or joints for retort mouthpieces." Dec. 8.
28,584.—Julius Pintsch Akt.-Ges., "Lighting and extinguishing gas-lamps." Dec. 8.
28,647.—Little, N. E., "Gas-heaters." Dec. 9.
28,653.—Harris, G., "Pipe-rust interceptor." Dec. 9.
28,662.—Jones, A. O., "Quenching coke." Dec. 9.



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RADIATORS
UNSURPASSED FOR EFFICIENCY
AND
ECONOMY IN GAS CONSUMPTION
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The PARKINSON STOVE CO., Ltd.
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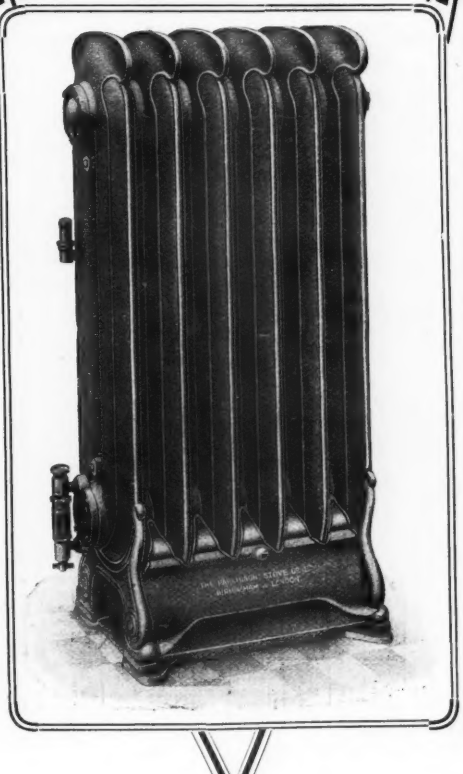

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situation Vacant.
WORKS CHEMIST. No. 5332.

Situations Wanted.
FOREMAN (Incandescent Light) O.U. 8571. Rudolf Mosse, Berlin.
CLERK. No. 5331.

Pupil, Vacancy for. No. 5334.

Plant, &c. (Second-Hand), for Sale.
MAIN DRILLING APPARATUS, &c. No. 5333.
PUMPING ENGINE, PUMPS, &c. Tonbridge Water Works Company.

Lectures.
DISTRIBUTION AND USES OF COAL GAS, AND BYE PRODUCT COKING PROCESSES. Leeds University. Particulars of the Registrar.
GASEOUS FUEL AND COMBUSTION. Imperial College of Science and Technology. Particulars of Secretary.

TENDERS FOR

Conveying and Elevating Plant.
BUDAPEST CORPORATION. Tenders by March 16.

Fire-Clay Goods.
LEICESTER CORPORATION. Tenders by Dec. 31.
MANCHESTER GAS DEPARTMENT. Tender by Jan. 12.
ROTHERHAM GAS DEPARTMENT. Tenders by Dec. 29.

Gasholder, &c.
BUDAPEST CORPORATION. Tenders by March 16.

General Stores.
ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY. Tenders by Dec. 27.

Pipes, &c.
G. E. WOODFORD, Ruabon.
LEICESTER CORPORATION. Tenders by Dec. 31.

Purifiers, &c.
NEWTOWNARDS URBAN DISTRICT COUNCIL. Tenders by Dec. 29.

Oxide (Spent).
KINGS LYNN GAS COMPANY.

Tar and Liquor.
HARROGATE GAS COMPANY.
HARWICH GAS COMPANY. Tenders by Jan. 6.
SHEFFY GAS COMPANY. Tenders by Jan. 2.

Waggons.
LEEK LIGHTING COMMITTEE. Tenders by Dec. 30.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Dec. 17. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast. Liverpool.	West Coast. Manchester.	Glasgow.
Tar crude	per ton	21/-	18/6 21/-	19/- 21/3	19/- 21/-	19/- 21/-	—
Pitch*	„	36/-	33/6	34/-	34/6	34/- 34/6	33/-
Benzol, 90 %	per gallon	-/9	-/7¼ -/8¼	-/8	-/7¼ -/7¼	-/8	-/8
Benzol, 50-90%	„	-/10	-/8¼ -/8½	-/9	-/8 -/8¼	-/8½ -/8½	—
Toluol, 90%	„	-/10	-/9 -/9¼	-/10	-/10	-/9¾	-/10
Crude naphtha, 30%	„	—	-/3¼ -/3½	-/3½	-/3¼ -/3½	-/3⅝	—
Light oil, 50%	„	—	-/3¼	-/3½ -/3¾	-/3 -/3¼	-/3 -/3¼	—
Solvent naphtha, 90-160	„	—	-/10½ -/11	-/10	-/10	-/11½ 1/-	-/11
Heavy naphtha, 90-190	„	—	-/11	-/11	-/11⅛	-/11⅛	-/11
Creosote in bulk	„	-/2⅜ -/2¾	-/2 -/2⅛	-/2	-/2 -/2⅛	-/2 1/16	-/2
Heavy oils	„	-/3¼	-/2⅜ -/3	-/2¼	-/2⅜	-/2⅝	-/2⅞
Carbolic Acid, 60's	„	1/1	1/- 1/1	1/1	1/- 1/1	1/0½ 1/1	1/1
Naphthalene, crude drained salts	per ton	—	42/6 45/-	40/- 42/6	47/6	47/6 50/-	—
„ pressed	„	—	60/-	63/-	60/-	60/- 72/6	—
„ whizzed	„	—	—	—	70/- 72/6	60/- 75/-	65/-
Anthracene	per unit	-/2	-/1⅜	-/1½	-/1¼	-/1¼	—

* Advancing.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 835.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct 14	5	Alliance & Dublin Ord.	79–82	−4	6 1 11
374,000	Stk.	July 14	4	Do. 4 p.c. Deb.	96–98	..	4 1 8
200,000	5	Oct. 28	7	Bombay, Ltd.	6⅝–6⅞	..	5 1 10
40,000	5	,,	7	Do. New, £4 paid	5–5¼	..	5 6 8
50,000	10	Aug. 31	15	Bourne-mouth Gas and Water } 10 p.c. B 7 p.c. Pref. 6 p.c.	28⅜–29⅛	..	5 1 8
311,810	10	,,	7		16⅜–16¾	..	4 3 7
75,000	10	,,	6		14⅜ –15⅜	..	3 18 8
380,000	Stk.	Aug. 12	12½	Brentford Consolidated	248–251	..	4 19 7
330,000	,,	,,	9⅜	Do. New	189–191	+3	4 19 6
50,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
206,250	,,	Dec. 15	4	Do. 4 p.c. Deb.	97 - 99*	..	4 0 10
220,000	Stk	Aug. 31	11	Brighton & Hove Orig.	215– 218	..	5 0 11
246,320	,,	,,	8	Do. A Ord. Stk.	158 –161	..	4 19 5
460,000	20	Sept. 29	10⅝	British	44 –45	..	4 12 4
109,000	Stk.	Aug. 14	6	Bromley, A 5 p.c.	117–119	..	5 0 10
165,700	,,	,,	4⅜	Do. B 3½ p.c.	88–90	..	5 0 0
82,278	,,	,,	5⅜	Do. C 5 p.c.	107–109	..	5 0 11
55,000	,,	June 29	3⅜	Do. 3½ p.c. Deb.	85–87	..	4 0 6
250,000	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	97–99	..	4 0 10
100,000	10	—	—	Cape Town & Dis., Ltd.	3–4	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4¼–5¼	..	—
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	—	..	—
100,000	Stk.	June 29	4½	Do. 4½ p.c. Deb. Stk.	90–92	..	4 17 10
157,150	Stk.	Aug. 12	5	Chester 5 p.c. Ord.	109½–111½	..	4 9 8
1,513,280	Stk.	,,	5 5/16	Commercial 4 p.c. Stk.	106–109	..	4 15 5
560,000	,,	,,	5	Do. 3½ p.c. do.	101–103	..	4 17 1
475,000	,,	Dec. 15	3	Do. 3 p.c. Deb. Stk.	77–79*	−½	3 15 11
800 000	Stk.	,,	4	Continental Union, Ltd.	86 –91*	..	4 7 11
200,000	,,	,,	7	Do. 7 p.c. Pref.	134–136*	+½	5 2 11
492,270	Stk.	—	5⅛	Derby Con. Stk.	122–124	..	4 8 9
55,000	,,	—	4	Do. Deb. Stk.	104–105	..	3 16 2
148,995	,,	Oct. 14	5	East Hull 5 p.c. Ord.	103–105	..	4 15 3
486,092	10	July 14	12	European, Ltd.	23¾–24¼	..	4 19 0
354,060	10	,,	12	Do. £7 10s. paid.	17¾–18¼	..	4 18 8
16,179,445	Stk.	Aug. 12	4⅜	Gas light and } 4 p.c. Ord.	105¼–106⅜	..	4 7 5
2,600,000	,,	,,	3⅛	3½ p.c. max.	87–89	..	3 18 8
4,062,235	,,	,,	4	4 p.c. Con. Pref.	103–105	..	3 16 2
4,511,705	,,	Dec. 15	3	Coke 3 p.c. Con. Deb.	78–80*	..	3 15 0
858,740	Stk.	Sept. 15	5	Hastings & St. L. 3½ p.c.	92–94	..	5 6 5
82,500	,,	,,	6⅛	Do. do. 5 p.c.	114–116	..	5 12 1
70,000	10	Oct. 14	11	Hongkong & China, Ltd.	17–17⅛	..	6 5 8
131,070	Stk.	Sept. 15	7⅜	Ilford A and C	145–148	..	4 19 8
65,780	,,	,,	5⅜	Do. B	114–116	..	5 1 3
65,500	,,	June 29	4	Do. 4 p.c. Deb.	98 –100	..	4 0 0
£							
4,940,000	Stk.	Nov. 11	9	Imperial Continental	185–187	..	4 16 3
1,235,000	Stk.	Aug 12	3⅛	Do. 3½ p.c. Deb. Red.	94–96	..	3 12 11
200,242	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c.	120—,21	..	4 18 4
561,000	Stk.	,,	10	Liverpool United A.	220—222	..	4 10 1
718,100	,,	,,	7	Do. B	164—165	..	4 4 10
306,083	,,	June 29	4	Do. Deb. Stk.	104—106	..	3 15 6
75,000	5	Dec. 15	6	Malta & Mediterranean.	4⅜–4⅝*	..	6 3 1
560,000	100	Oct. 1	5	Met. of } 5 p.c. Deb.	99–101	..	4 19 0
250,000	100	,,	4½	Melbourne } 4½ p.c. Deb.	99 –101	..	5 9 10
541,920	20	Nov. 11	3⅜	Monte Video, Ltd.	12½–12¾	..	5 9 10
1,775,892	Stk.	July 28	4⅜	Newc'tle & G'tesh'd Con.	102–103	..	4 5 0
529,435	Stk.	June 29	3⅜	Do. 3½ p.c. Deb.	90–91	..	3 16 11
55,940	10	Aug. 31	7	North Middlesex 7 p.c.	13⅜–14⅜	..	4 16 7
300,000	Stk.	Nov. 30	8	Oriental, Ltd.	137–139	+1	5 15 1
60,000	5	Sept. 15	8	Ottoman, Ltd.	6¼–6⅝	..	5 18 6
31,800	53	Aug. 31	13	Portsea Island A.	131–133	..	5 3 0
60,000	50	,,	13	Do. B.	124–126	..	5 3 2
100,000	50	,,	12	Do. C.	117–119	..	5 0 10
114,800	50	,,	10	Do. D and E.	102–104	..	4 16 2
398,490	5	Oct. 28	7	Primitiva Ord.	7⅜–7¾	..	4 13 4
796,980	5	June 29	5	Do. 5 p.c. Pref.	5⅛–5⅜	+⅛	4 10 11
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	95–97	..	4 2 6
312,650	Stk.	June 29	4	River Plate 4 p.c. Deb.	97–99	..	4 0 10
250,000	10	Sept. 29	9	San Paulo, Ltd.	15⅛–15⅝	..	5 14 3
115,000	10	,,	6	Do. 6 p.c. Pref.	11¼–11½	..	5 2 2
125,000	50	July 1	5	Do. 5 p.c. Deb.	51–52	..	4 16 2
135,000	Stk.	Aug. 31	10	Sheffield A	229–231	..	4 6 7
209,984	,,	,,	10	Do. B	229–231	..	4 6 7
523,500	,,	,,	10	Do. C	229–231	..	4 6 7
70,000	10	Oct. 14	6	South African	10¼–11½	..	5 6 8
6,429,895	Stk.	Aug. 12	5/9/4	South Met., 4 p.c. Ord.	121–123	..	4 8 10
1,895,445	,,	July 14	3	Do. 3 p.c. Deb.	80–82	..	3 13 2
209,820	Stk.	Aug. 31	8	South Shields Con. Stk.	155–157	..	5 1 11
605,000	Stk.	Aug. 12	5⅜	S'th Suburb'n Ord. 5 p.c.	120–122	..	4 12 9
60,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
117,058	,,	July 14	5	Do. 5 p.c. Deb. Stk.	122–124	..	4 0 8
502,310	Stk.	Nov. 11	5	Southampton Ord.	109–111	..	4 10 1
120,000	Stk.	Aug. 12	7	Tottenham and } A 5 p.c. B 3½ p.c.	141–143	..	4 17 11
483,940	,,	,,	5⅜		112–114	..	4 16 6
149,470	,,	Dec. 15	4	Edmonton } 4 p.c. Deb.	55–97*	..	4 2 6
182,380	10	June 10	8	Tuscan, Ltd.	9–9⅜	..	8 8 6
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	98–100	..	5 0 0
236,476	Stk.	Aug. 31	5	Tynemouth, 5 p.c. max.	113–115	..	4 6 11
255,636	Stk.	Aug. 31	6⅛	Wands-worth } B 3½ p.c. 3 p.c. Deb. Stk.	140–142	..	4 15 1
85,765	,,	June 29	3		74–76	..	3 18 11

Prices marked * are "Ex div."

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

CHRISTMAS HOLIDAY.

In consequence of the CHRISTMAS HOLIDAYS, it will be a convenience if Communications for the next issue of the "JOURNAL" and Orders respecting ADVERTISEMENTS are received at the Office by 10 o'clock ON FRIDAY MORNING at latest.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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GAS LIGHTING ENGINEERS AND CONTRACTORS,
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See Illustrated Advertisement, Oct. 25, p. 238.

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SULPHURIC ACID for Sale, specially suitable for making Sulphate of Ammonia.
Brotherton and Co., Ltd., Chemical Manufacturers, Works: Birmingham, Leeds, Sunderland, and Wakefield.

CALCIDUM, a Limpid, Colourless, Neutral Liquid; does not affect Metals, freezes only at -67° F., and, therefore, when mixed with Water in Gas Meters, Engines, Generators, &c., prevents these Freezing in the most severe weather. It is also the best means of thawing everywhere, for Extinguishing Fires, and for working Mortar and Cement in Winter. Used regularly for Eight Years by one English Gas Company.
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Consumers in any form are invited to correspond with Chance and Hunt, Ltd., Chemical Manufacturers, Oldbury, Worcs.

"GAZINE" (Registered in England and Abroad). A radical Solvent and Preventative of Naphthalene Deposits, and for the Automatic Cleaning of Mains and Services.
It is also used for the enrichment of Gas.
Manufactured and supplied by C. Bourne, West Moor Chemical Works, Killingworth, or through his Agent, F. J. Nicol, Pilgrim House, Newcastle-on-Tyne.
Telegrams: "Doric," Newcastle-on-Tyne. National Telephone No. 2497.

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THE Second Part of a Special Course of ADVANCED LECTURES, as follows, will begin during January next:—
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Conducted by
Professor W. A. BONE, D.Sc., Ph.D., F.R.S.
Particulars of this, and other Courses to Follow, Free on Application to the Secretary.

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SPECIAL LECTURE COURSES OPEN TO THE PUBLIC.

(*A.*) The Distribution and Uses of Coal Gas.—

A COURSE of 22 Lectures on Wednes- days at Six p.m. and Thursdays at Nine a.m., during Eleven consecutive weeks, as under:—
1911.
Jan. 11 to Feb. 2.—Eight Lectures on "Distribution of Coal Gas," by Mr. Walter Hole, of Leeds.
Feb. 8 to 16.—Four Lectures on "Gaseous Combustion and Structure of Flames," by Professors Bone and Smithells.
Feb. 22 to March 9.—Six Lectures on "The Uses of Coal Gas for Heating Purposes," by Mr. John Bond, of Southport.
March 16 to 24.—Four Lectures on "Gas Lighting and Photometry," by Mr. Jacques Abady, of London.
Fee for the whole Course £1 1s., or 10s. 6d. for a Single Section thereof.

(*B.*) Bye-Product Coking Processes.—
A Course of Eight Lectures on Saturdays at 3.30 p.m. Commencing Jan. 21, 1911, by Mr. Ernest Bury, M.Sc., of the Skinningrove Iron Company, Limited.
Fee for the Course, 10s. 6d.
For further Particulars Apply to the Registrar.

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THIS Situation is now Filled. Testi- monials will be returned on Request.
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Address No. 5331, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

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WORKS Chemist wanted for Works in Yorkshire, Age 22 to 30, of Sound Training, with Works Experience and some Engineering Knowledge. Gas-Works Practice desirable, but not essential.
Apply, by letter, stating Full Particulars, and Salary required, to No. 5332, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

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FOR SALE—Complete Gas-Making PLANT, including New Gasholder and Steel Tank, 10,000 Cubic Feet capacity, ready for delivery, with Condensers, Scrubber, Purifiers, &c. Erected complete in England for £1200. Detailed Plan and Specification submitted.
TWO PURIFIERS, 12 ft. by 8 ft. by 5 ft. deep. Three Purifiers 5 ft. 6 in. square, complete with Four-Way Valves and Connections. Re-Erected cheap for immediate Sale.
GASHOLDERS, 16 ft., 24 ft., 26 ft., 30 ft., 42 ft., and 45 ft. diameter. Also 70,000 and 200,000 Cubic Feet capacity Gasholders. Cheap for immediate Sale. Re-Erected in either brick or new Steel Tanks. Full Particulars and Quotation submitted.
Firth Blakeley, Sons, and Company, Limited, Thornhill, Dewsbury.

SPENT OXIDE.

THE Kings Lynn Gas Company invite TENDERS for about 150 Tons SPENT OXIDE. Particulars and Samples of the undersigned,
Edmund G. Smithard,
Engineer.

LEEK URBAN DISTRICT COUNCIL.

COAL WAGGONS.

THE Lighting Committee of the above Council invite TENDERS for the Supply of Eight new 12-TON COAL WAGGONS for the Gas Department.
Specification and Form of Tender can be obtained from the undersigned.
Sealed Tenders, addressed to the Chairman of the Lighting Committee, to be delivered at the Town Hall, Leek, not later than the 30th of December, 1910.
The lowest or any Tender will not necessarily be accepted.

S. Trow Smith,
Engineer and Manager.

Gas-Works, Leek,
Dec. 10, 1910.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

THE Directors of the above Company are prepared to receive TENDERS from Iron-founders, Gun-Barrel Manufacturers, Timber Merchants, Druggists, Rope Makers, &c., for GOODS to be delivered on the Company's Works, Great Brunswick Street, in such quantities as may be required from time to time up to Dec. 31, 1911.
Samples of Goods required are open to inspection on the Works, Great Brunswick Street; and printed list of the articles required can be had on Application to the Company's Offices, D'Olier Street.
Tenders, endorsed "Tenders for Stores," to be lodged in my office on or before the 27th inst.

Francis T. Cotton,
Secretary and Manager.

Head Office: D'Olier Street,
Dublin, Dec. 14, 1910.

CAPITAL AND RESIDENCE OF BUDAPEST.

NOTICE.—Based upon his resolution No. 106,956 of December 1, 1910, the Magistrat of the Capital and Residence of Budapest brings herewith to the knowledge of all those whom it may interest that the TERM for submitting TENDERS for the Supply of TWO GASOMETERS and a COAL AND COKE-TRANSMISSION for the Central Gas-Works of the Capital and Residence of Budapest, has been *ADJOURNED* from the 28th of January, 1911, to the 16th day of March, 1911.
In consequence, Tenders for the Supply of the Two Gasometers and the Coal and Coke-Transmission for the Central Gas-Works of the Capital and Residence of Budapest are to be handed in on the 16th day of March, 1911, 12h merid., to Mr. Dr. János Buzáth, Chief of Section (Budapest IV. Városház-utcza 16. II.), but *NOT* to the Councillor Mr. Bátor Piperkovits.
The other Dispositions of Conditions, Specifications, &c., remain unaltered.

CORPORATION OF LEICESTER.
(Gas Department.)

RETORTS AND FIRE-BRICKS.

THE Gas Committee of the above Cor- poration are prepared to receive TENDERS for the Supply and Delivery of RETORTS and FIRE-BRICKS required for the Year 1911.
Specification, Quantities, and Form of Tender can be obtained upon Application to the Engineer.
Tenders, addressed to Mr. Alderman T. Smith, J.P., Chairman, and endorsed "Tender for Retorts, &c.," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, Dec. 31, 1910.
The Committee do not bind themselves to accept the lowest or any Tender.

Hubert Pooley, Assoc.M.Inst.C.E.,
Engineer and Manager.

Gas Offices: Millstone Lane,
Leicester, Dec. 12, 1910.

CORPORATION OF LEICESTER.
(Gas Department.)

CAST-IRON PIPES.

THE Gas Committee of the above Cor- poration are prepared to receive TENDERS for the Supply and Delivery of the necessary CAST-IRON PIPES and CONNECTIONS, from 2 to 36 inches in diameter, required during the Twelve Months ending the 31st of December, 1911.
Specification and Form of Tender can be obtained upon Application to the Engineer.
Tenders, addressed to Mr. Alderman T. Smith, J.P., Chairman, and endorsed "Tender for Pipes, &c.," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, Dec. 31, 1910.
The Committee do not bind themselves to accept the lowest or any Tender.

Hubert Pooley, Assoc.M.Inst.C.E.,
Engineer and Manager.

Gas Offices: Millstone Lane,
Leicester, Dec. 12, 1910.

MANCHESTER CORPORATION GAS-WORKS.

THE Gas Committee invite Tenders for the Supply and Delivery of the FIRE-CLAY GOODS required during next season at their several Gas-Works.
Full Particulars and Forms of Tender may be obtained from Mr. Fredk. A. Price, Superintendent, at the Gas Offices, Town Hall, Manchester, on payment of a deposit of Two Guineas, which will be returned on receipt of a *bona-fide* Tender.
Sealed Tenders, endorsed "Tender for Fire-Clay Goods," addressed to the Chairman of the Gas Committee, must be delivered at the Gas Offices, Town Hall, Manchester, on or before Thursday, the 12th of January, 1911.
The Gas Committee do not bind themselves to accept any Tender, and reserve the right to divide any Offer as they may deem advisable.

By order,
Thos. Hudson,
Town Clerk.

Town Hall, Manchester,
Dec. 16, 1910.

WANTED, Tender for 1800 Yards of 6-inch, 500 Yards of 10-inch, and 300 Yards of 8-inch CAST-IRON PIPES; also SPECIALS.
For Particulars, Apply to GEO. E. Woodford, RUABON.

GAS TAR AND AMMONIACAL LIQUOR.

THE Harrogate Gas Company invite OFFERS for their Surplus TAR and AMMONIACAL LIQUOR for the Year 1911.
For Particulars, Apply to H. WILKINSON, Secretary and General Manager, Gas Offices, James Street, HARROGATE.

HARWICH GAS AND COKE COMPANY.

TENDERS are invited for the Surplus TAR produced at this Company's Works for the Year ending Dec. 31, 1911.
The Tar will be delivered free into Railway Tank Waggons or Tank Barges at this Works.
Probable quantity, 120 Tons.
The Directors do not bind themselves to accept the highest or any Tender.
Sealed Tenders to be delivered addressed to me, not later than the 6th day of January, 1911.
GEO. BAINES,
Secretary.

COUNTY BOROUGH OF ROTHERHAM.

THE Gas-Works Committee of the Rotherham Corporation are prepared to receive TENDERS for the Supply of RETORTS and FIRE-CLAY GOODS.
Specifications, Quantities, and Forms of Tender may be obtained on Application to the undersigned.
The person whose Tender is accepted will be required to enter into a Contract which will contain the usual Fair-Wages Clause.
Tenders, endorsed "Retorts and Fire-Clay Goods," must be sent to the Town Clerk, Town Hall, Rotherham, not later than Thursday, the 29th inst.
By order,
J. S. NAYLOR,
Engineer and General Manager.

THE Directors of the Sheppy Gas Company invite TENDERS for the Purchase of the Surplus TAR produced at their Works from the 1st of January to the 31st of December, 1911.
Approximate Quantity, 40,000 to 50,000 Gallons.
May be removed by Water or Rail. If the latter, the Contractor must provide his own Casks and accept Delivery at Sheerness Dockyard Station.
Tenders to be sent to the undersigned not later than the 2nd of January, 1911.
The Directors do not bind themselves to accept the highest or any Tender.
By order,
H. BARBER,
Secretary and General Manager.
Gas Offices, Sheerness,
Dec. 15, 1910.

NEWTOWNARDS (CO. DOWN) URBAN DISTRICT COUNCIL.

GAS-WORKS EXTENSION.

THE above Council hereby invite TENDERS for the Supply and Erection of One Set of Three PURIFIERS, each 20 ft. by 20 ft. by 5 ft., with 12-inch Connections, &c., in accordance with Plans and Specification prepared by Mr. W. H. Roberts, the Council's Engineer.
Copy of Plans and Specification will be supplied by me to intending Contractors on payment of One Guinea, returnable on receipt of *bonâ-fide* Tender.
Tenders, endorsed "Tender for Purifiers," will be received by me up to noon on Thursday, the 29th inst.
The Council do not bind themselves to accept the lowest or any Tender.
H. MCCARTNEY,
Clerk to the Council.
Town Hall, Newtownards,
Dec. 14, 1910.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MESSRS. A. & W. RICHARDS beg to notify that their SALES BY AUCTION of NEW CAPITAL ISSUED UNDER PARLIAMENTARY POWERS, and of STOCKS and SHARES belonging to EXECUTORS and other PRIVATE OWNERS in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES, take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.
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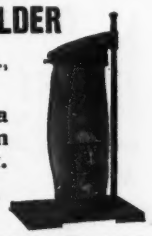

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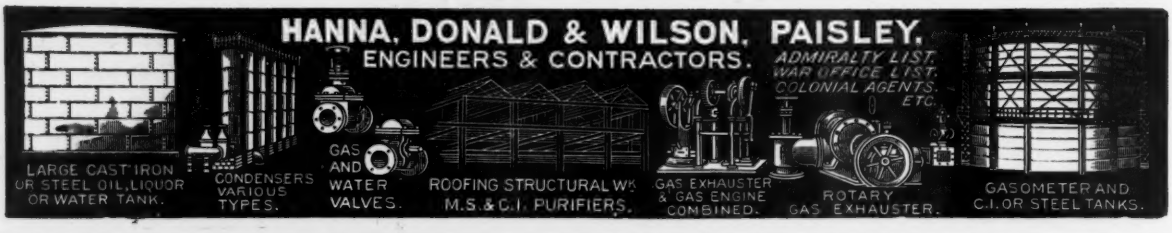
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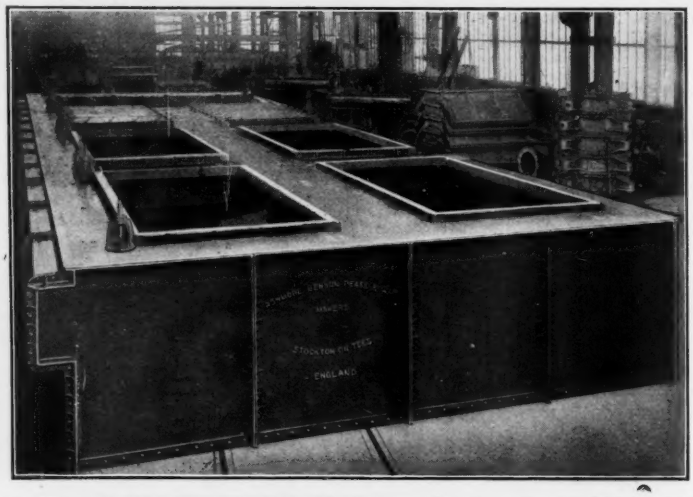

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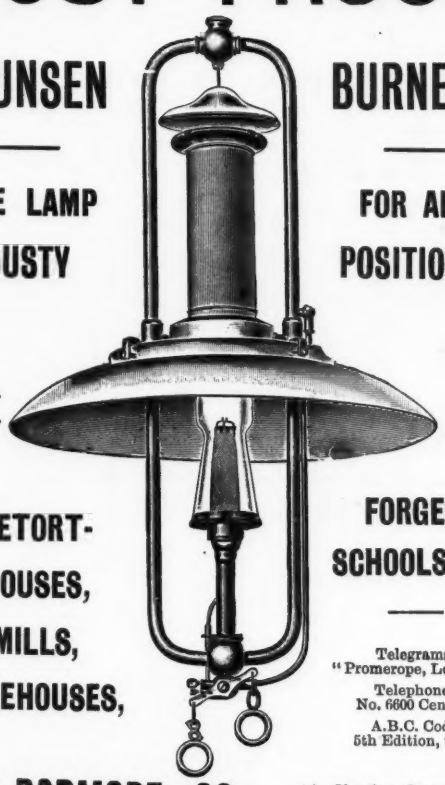

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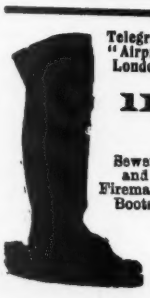

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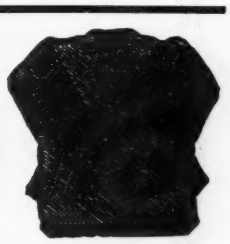

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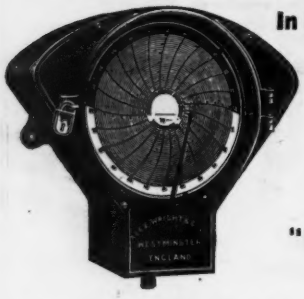

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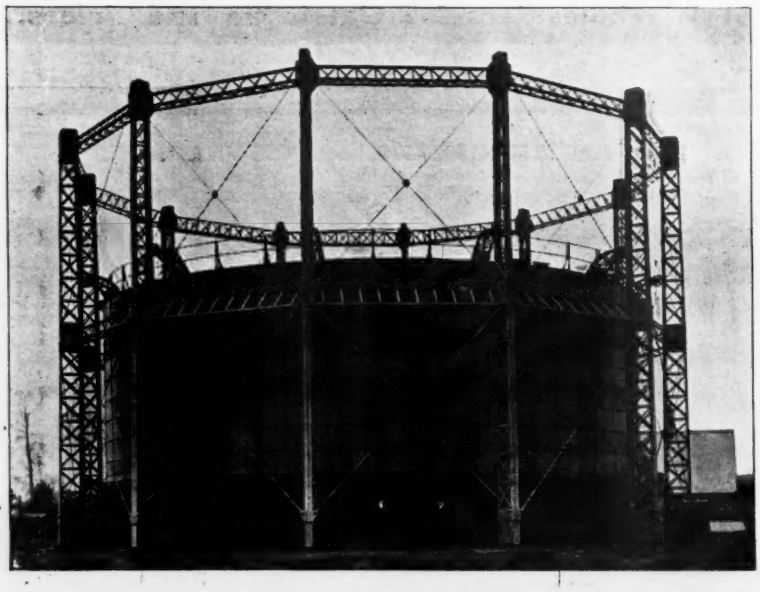

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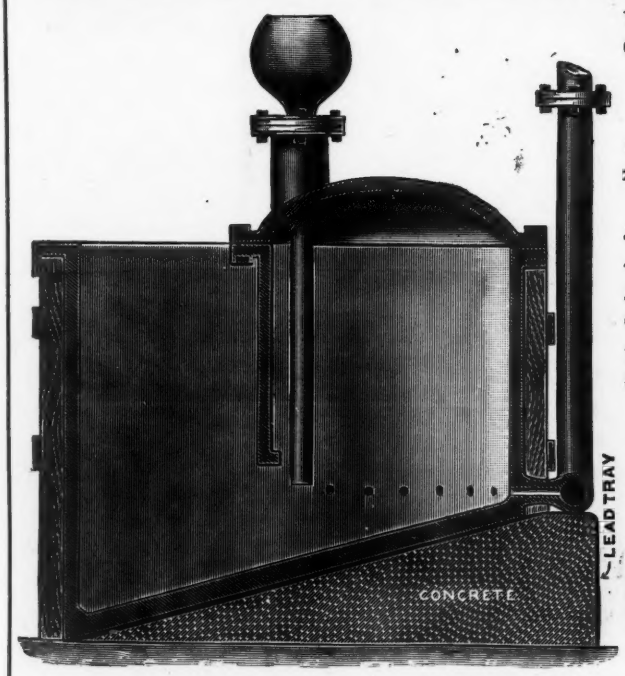

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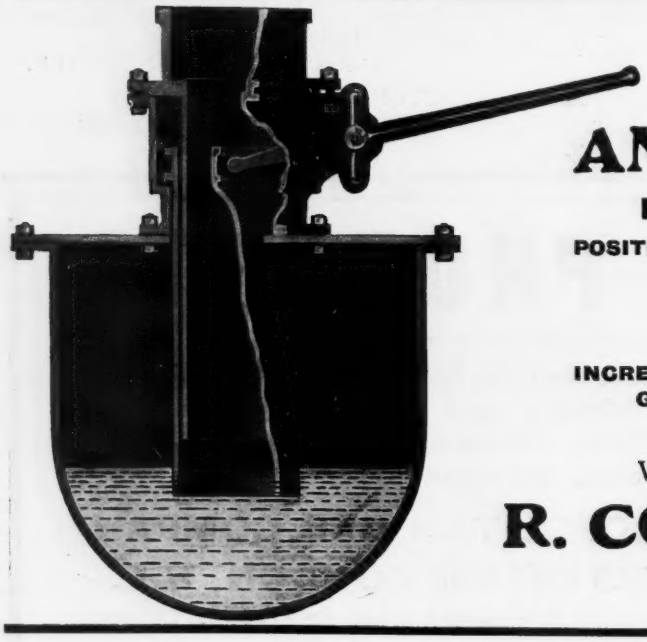

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Welsbach
LIGHT
Inverted Arc Lamp, Fig. 623.

Storm Proof—
For Exterior Lighting.

Welsbach-Kern
(Patent) Inverted System

BRITISH MADE.

BRITISH MADE.

Height over all.

1-light . . .	1 ft. 8 ins.
2-light . . .	2 ft. 4 ins.
3-light . . .	2 ft. 4 ins.
4-light . . .	2 ft. 7 ins.

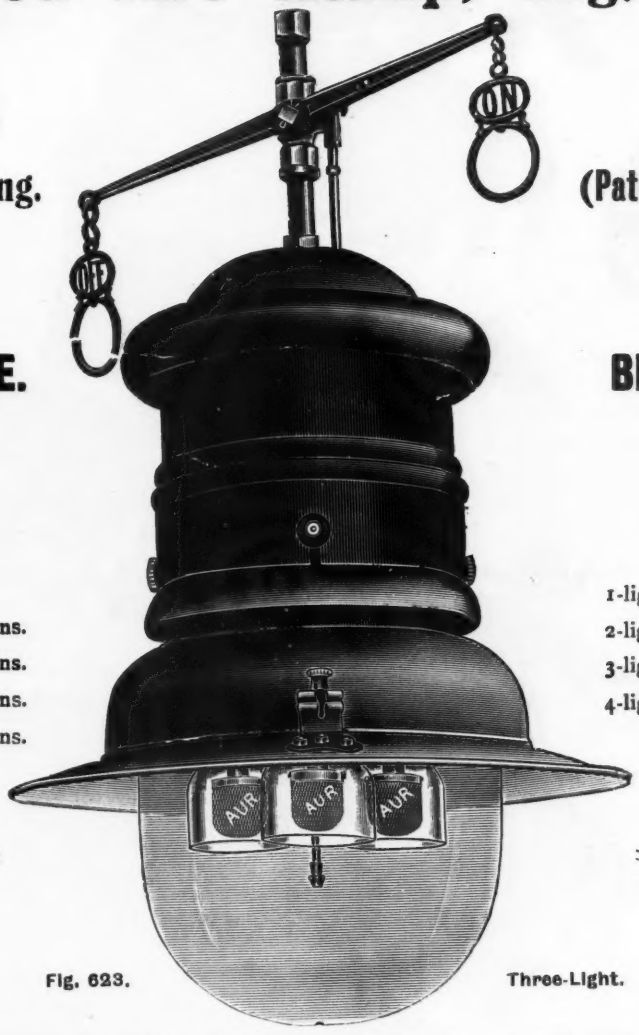

Fig. 623. Three-Light.

Width over all.

1-light . . .	1 ft. 1 in.
2-light . . .	1 ft. 5 ins.
3-light . . .	1 ft. 5 ins.
4-light . . .	1 ft. 8 ins.

ENAMELLED Green Steel Casing, fitted with Welsbach-Kern Inverted Burners, Gas and Air Regulators operated from outside. Sliding Door to give access to Burners for cleaning purposes. Fitted with Magnesia Nozzles, Welsbach Mantles, and Glass Mantle Protectors. Complete as shown. Highly efficient and regenerative.

	Gas per hour.	*C.P.*	*Steel.*	*Copper Case.*		*Gas per hour.*	*C.P.*	*Steel.*	*Copper Case.*
1-light	4 feet	125	**30/-**	**5/-** extra.	3-light	12 feet	400	**52/6**	**6/-** extra.
2-light	8 feet	260	**47/6**	**6/-** extra.	4-light	16 feet	550	**72/6**	**9/-** extra.

All on or off, or One light on and the rest off, **7/6** per Lamp extra. Cup and Ball, **3/6** per Lamp extra.

RENEWALS.

Glass Mantle Protectors (Fig. 623) **3/4½** per dozen, or in case lots of 5 gross, **33/-** per gross.

	1-Light.	*2-Light.*	*3-Light.*	*4-Light.*
Clear Glass Globes, each	**2/3**	**5/9**	**5/9**	**9/-**
" " " In Case lots per dozen.	**19/6**	**57/9**	**57/9**	**93/-**
Case contains . .	*80*	*18*	*18*	*12*

	1-Light.	*2-Light.*	*3-Light.*	*4-Light.*
Wired Globes, extra each	**2/-**	**2/-**	**2/9**	**3/6**
Parabolic Reflector, extra "	**3/6**	**6/-**	**7/6**	Not made

Welsbach Mantles, **4½d.** each, or **4s. 3d.** per dozen subject as usual.

The Welsbach Mantles for Upright lighting are "C," "CX," and "Plaissetty," price **4½d.** each.

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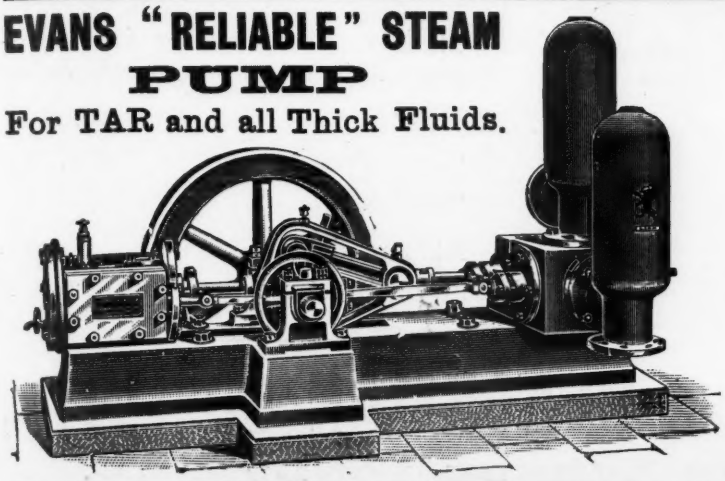

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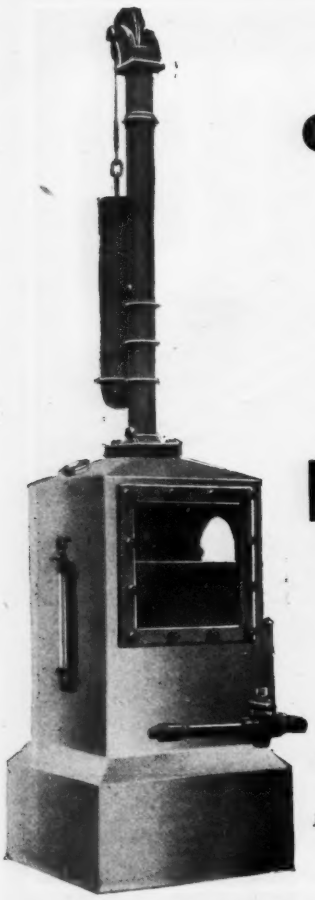

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